MAY 1941—FORTY-SEVENTH YEAR

MACHINERY

INDUSTRIAL PRESS Publishers. 140-148 LAFAYETTE ST., NEW YORK

MAY 10

Faster!

Easier!

PUSH-BUTTON CONTROL

BROWN & SHARPE

No 000

. . . FOR ACCURATE MILLING OF SMALL PARTS AT LESS COST

B·S

See pages 172 and 173

1,880,000 BEARING RACES *And Still Going Strong!*

A BEARING MANUFACTURER REPORTS — "Your Wheelhead Type 187-1 Unit 1612, Serial 6055 has been used constantly for 8,576 hours and during that time has ground 1,880,000 parts. It is still in continuous operation and apparently in perfect condition."

Yes, Heald Red Heads have certainly proven their stamina and superiority wherever installed. If you, as many manufacturers are at this time, considering repairs or the overhauling of your Internal Grinding Machines remember that only a wheelhead of the right style and size can produce maximum results and that one or two additional heads correct for each job will soon pay for themselves in quantity and quality.

A bulletin on sizes and styles of heads will be gladly sent you.

THE HEALD MACHINE CO. WORCESTER, MASS. U. S. A

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

MAY, 1941

Marked improvements in the operation of plastic injection molds may be expected if the suggestions pertaining to the design of molds given in the leading article in the June number of MACHINERY are followed. The author of the article, "Basic Factors in Injection Mold Design," has a background of extensive experience in the plastics field, and covers the subject in considerable detail. Other articles in the June number will deal with Motor Maintenance; Oxy-Acetylene Gouging; and Trade Training in Vocational Schools.

Volume 47
Number 9

PRINCIPAL CONTENTS OF THIS NUMBER

For Complete Classified Contents, See Page 188

Seventy Thousand Trucks for the United States Army *By Charles O. Herb* 105
Centerless Grinding of High-Nickel Alloys *By John H. Jaecker* 115
Unusual Methods Employed in Producing Hamilton Propellers *By Arvid Nelson* 117
Oil-Well Equipment Built to Drill 15,000 Feet *By Charles O. Herb* 125
Cutting Threads Close to a Shoulder with Self-Opening Die-Heads *By G. E. Mager* 129
Maintenance of Dies for Greater Production *By H. J. Hawk* 132
Unusual Tooling Arrangement for Machining Brake-Drums . . 139
Editorial Comment 140
Shell-Machining Chart . . . . . *By Dr. M. Kronenberg* 141
Electrically Operated Safeguards for Press Tools 147
Westinghouse Annual Machine Tool Forum 149

DEPARTMENTS

Ingenious Mechanical Movements 123
Engineering News Flashes 128
Design of Tools and Fixtures 135
Ideas for the Shop and Drafting-Room 146
Materials of Industry 150
New Trade Literature 152
Shop Equipment News 155
News of the Industry 180

Product Index 304-325
Advertisers Index 327-328

TOTAL DISTRIBUTION
19,725

PUBLISHED MONTHLY BY
THE INDUSTRIAL PRESS
148 Lafayette Street New York

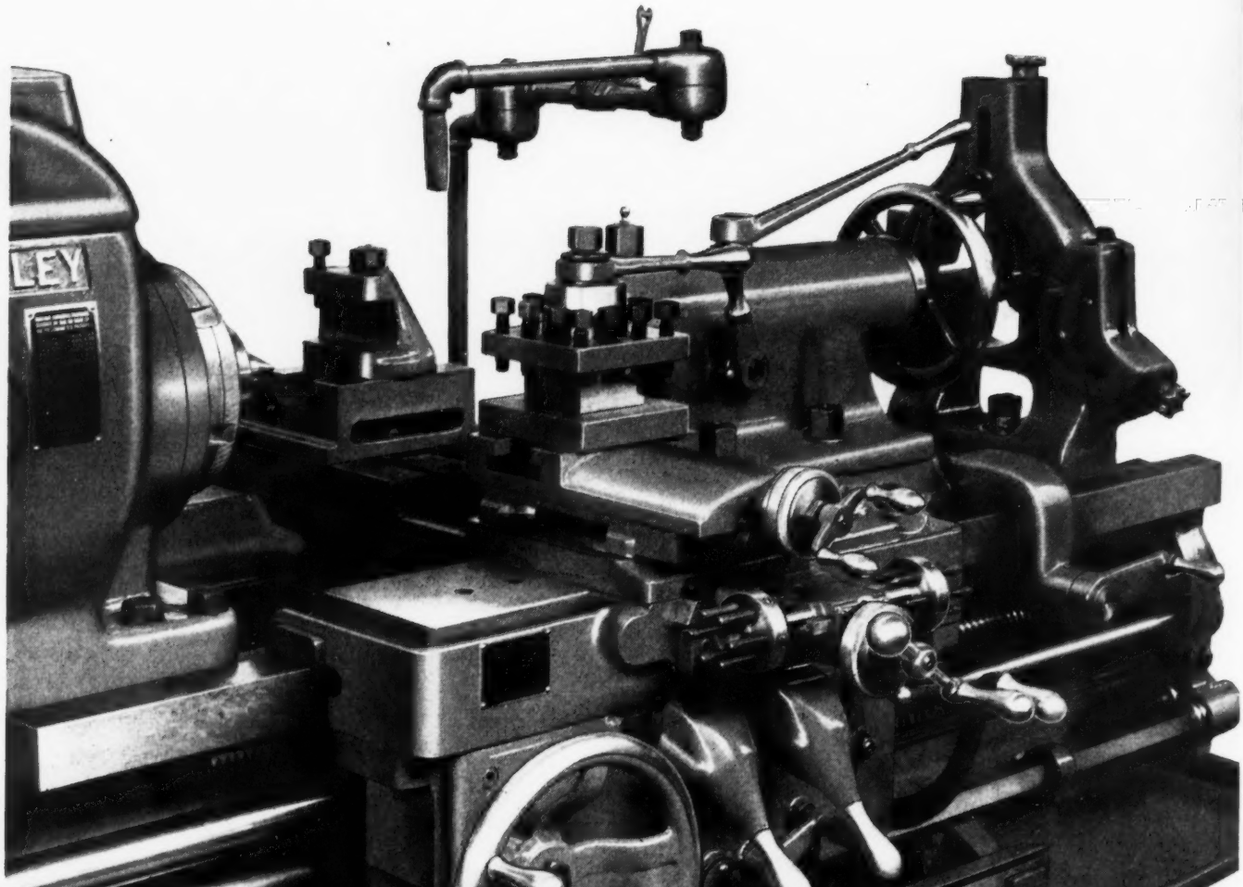
ROBERT B. LUCHARS ..... *President*
EDGAR A. BECKER *Vice-pres. and Treasurer*
ERIK OBERG ..... *Editor*
FRANKLIN D. JONES ..... *Associate Editor*
CHARLES O. HERB ..... *Associate Editor*
FREEMAN C. DUSTON ..... *Associate Editor*

LONDON: MACHINERY, 83-113 Euston Road
PARIS: La Machine Moderne, 15 Rue Bleue

SUBSCRIPTION RATES: United States and Canada, one year, $3; two years, $5; three years, $6 (for Canada add 25 cents per year for war tax); foreign countries, $6 a year. Single copies, 35 cents. Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Copyright 1941 by The Industrial Press.
Entered as second-class mail matter, September, 1894, at the Post Office, New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America. Member of A.B.P. Member of A.B.C.

A Profit Building Lathe



MACHINERY

NEW YORK, MAY, 1941

Volume 47 Number 9

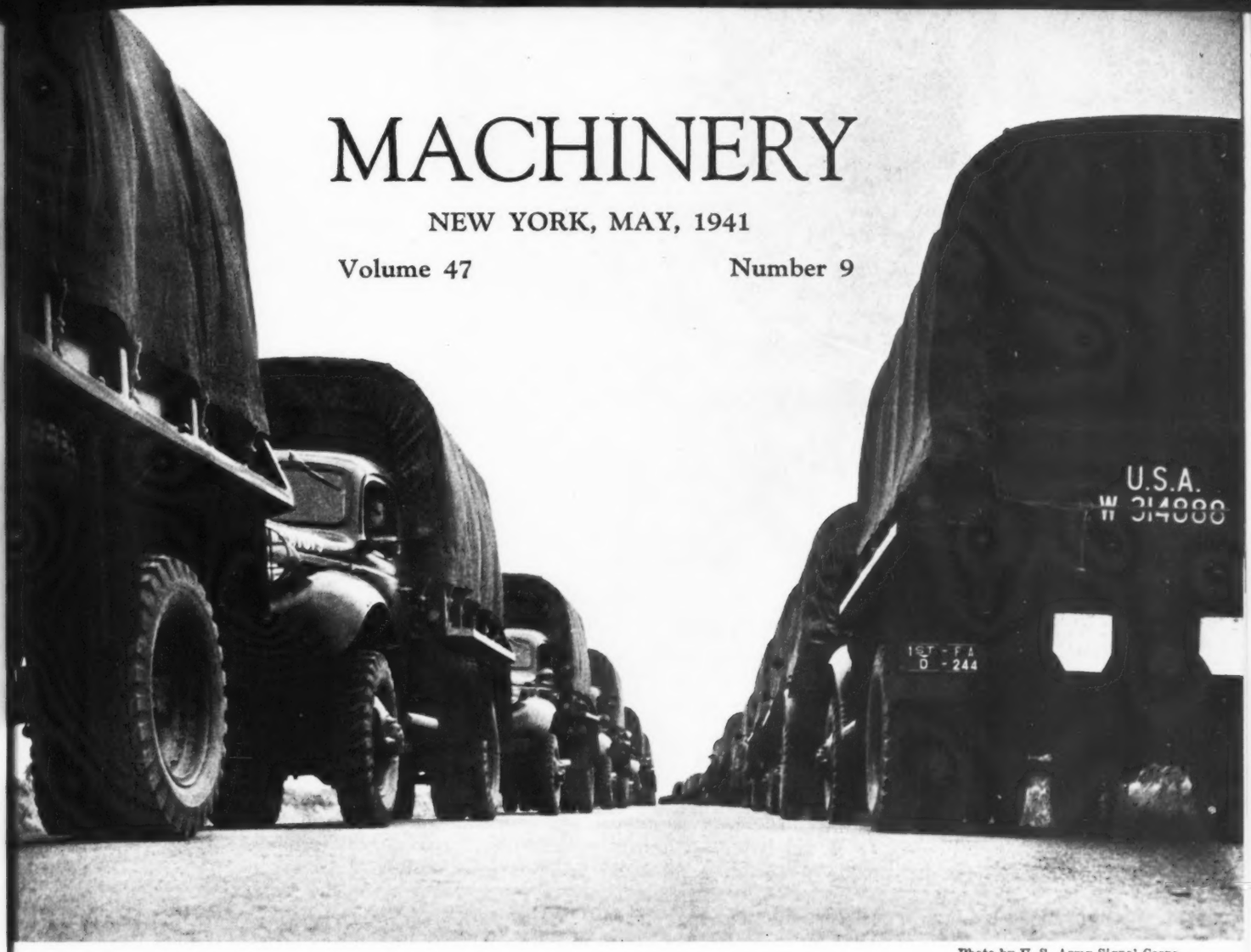


Photo by U. S. Army Signal Corps

Seventy Thousand Trucks for the United States Army

Orders for This Huge Number of Motor Trucks are being Rapidly Completed by Chrysler Corporation

By CHARLES O. HERB

WHEN General Pershing was assigned to lead our expeditionary forces into Mexico in 1916 to punish Pancho Villa, there were only a dozen motor trucks in the entire United States Army. To enable the expedition to travel quickly over the rough terrain of Mexico, some 4000 trucks and passenger cars were hastily bought. These motor vehicles had not been built to withstand the severe service demanded of them, and when the search for Villa was over, at least 2000 trucks were abandoned below our southern border.

That expedition showed conclusively the importance of automotive equipment in keeping a moving army supplied with food and munitions. When this country entered the World War in April of the following year, therefore, our Army had purchased 3039 motor trucks and 437 passenger cars designed specifically for military purposes. One and a half years later, at the close of that conflict,

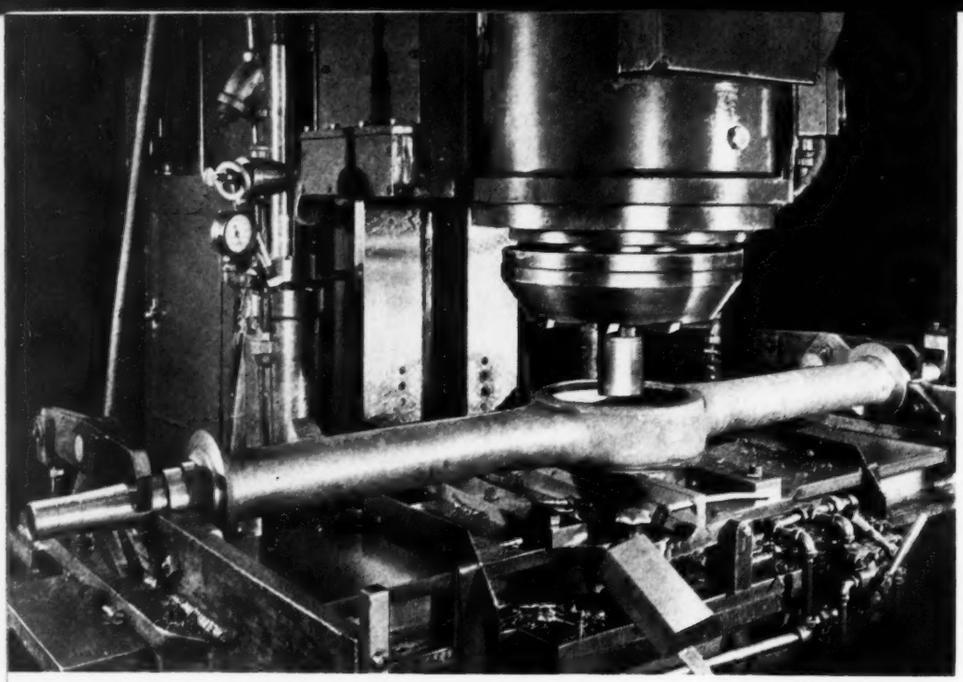


Fig. 1. Equipment Used for Face-milling the Banjo Faces of Rear-axle Housings, a Large-diameter Inserted-blade Cutter being Used

there were over 85,000 trucks in the United States Army, in addition to a large number of passenger automobiles and ambulances. Over 18,000 trucks had been in daily use in France for the transportation of men and supplies.

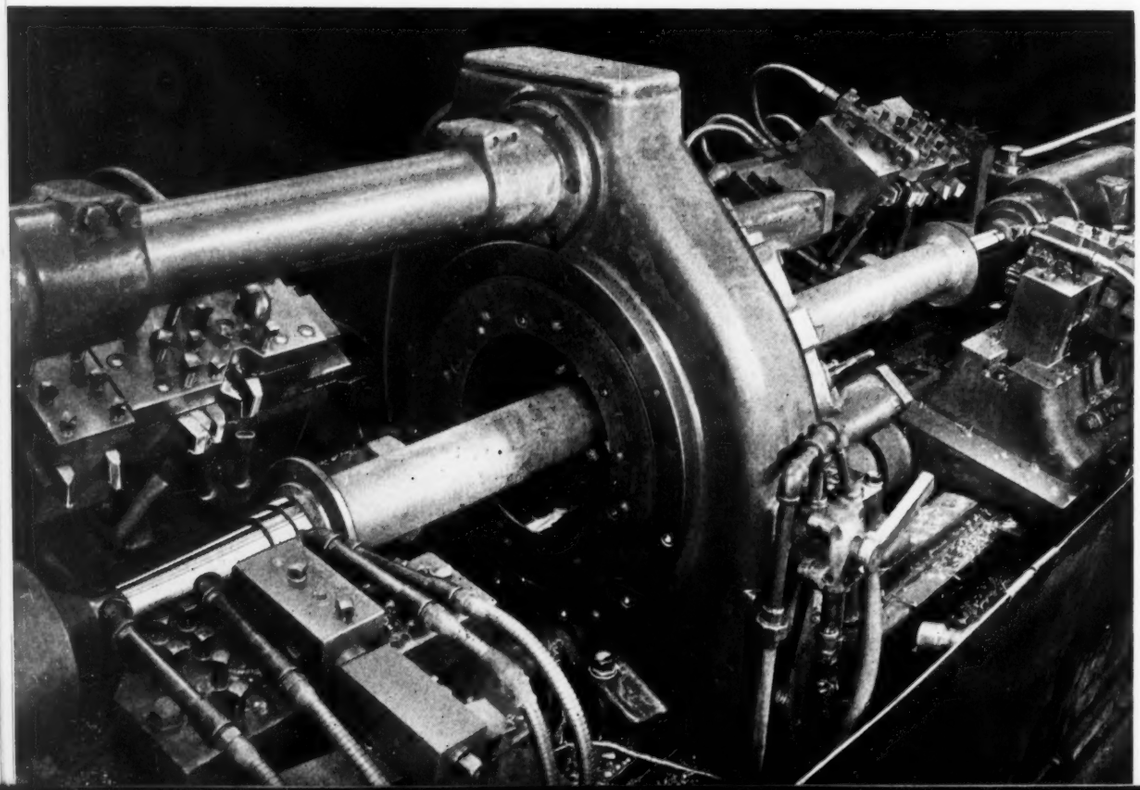
In the mechanized warfare being waged today in Europe, Africa, and Asia, the necessity of large numbers of motor trucks for maintaining supply and communication lines has become even more important than in the first World War. Little wonder then that our National Defense Program calls for huge numbers of motor trucks for transportation purposes and various types of passenger cars for reconnaissance activities. Chrysler Corporation alone, through its Fargo Division, had up to February 1, contracted to build over 70,000 Dodge trucks especially designed to meet Army requirements, at a cost of $69,000,000. They are being turned out at the rate of about 300 a day. At the end of 1940 approximately 19,000 of these trucks had been delivered to the Government.

Some of the outstanding methods used in producing parts for these trucks that differ from parts assembled into standard Dodge trucks will be described in this article. The methods described apply to axle units only, since the engines and transmissions are generally standard types and are produced by more usual methods.

Automatic Lathe Operations on Axle Units

Automatic lathes tooled up as illustrated in Fig. 2 are employed for rough- and finish-turning the axle ends of the rear-axle housings and facing

Fig. 2. Center-driven Automatic Lathe Tooled up for Simultaneously Finishing Axles on Ends of Rear-axle Housings and Facing and Chamfering the Work



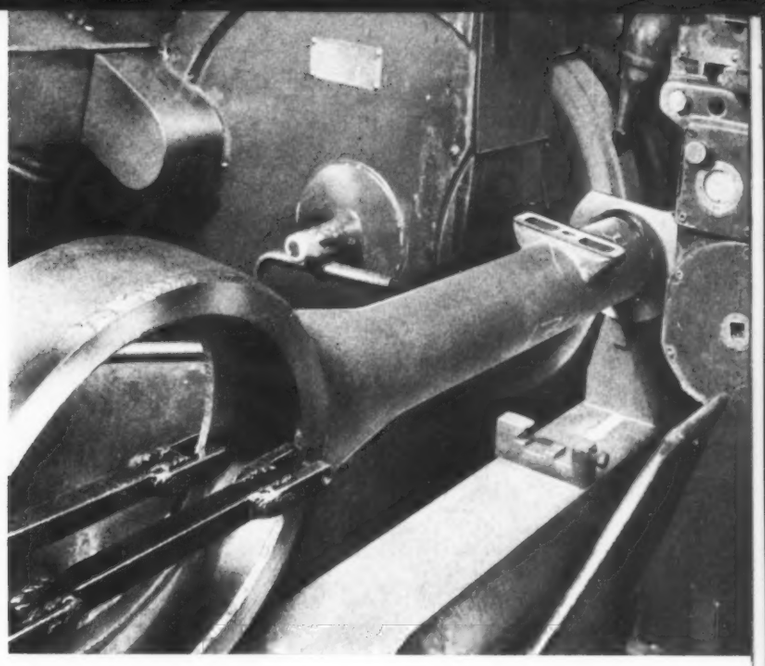


Fig. 3. Two Bearing Seats and an Oil Sealing Surface are Ground on Each End of the Rear-axle Housings by the Use of a Centerless Grinding Machine

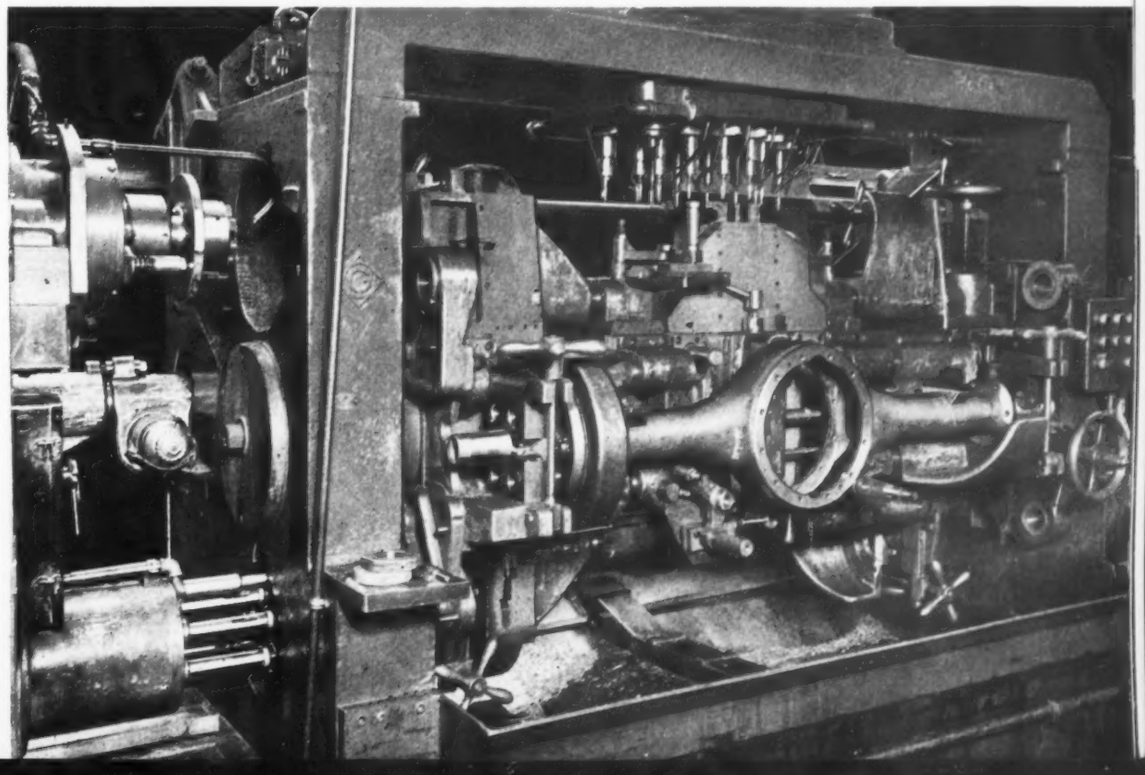
the wheel flanges. The illustration shows the finishing operation. In both roughing and finishing, the ends of the housings are supported between centers and the housing is driven from a central chuck. The work is located in the center-drive chuck from the inside of the banjo. Horizontal movement of the headstock and tailstock spindles is effected by air pressure.

Four cutters on each front carriage turn straight cylindrical surfaces on the axles, and four additional cutters turn the long tapered portion of the axles. The taper turning cutters are mounted in a block, which is fed radially in relation to the work by means of a standard taper attachment as the carriage moves along the bed of the machine. During the turning, the rear carriage at each end of the machine rocks forward to bring eight facing and chamfering cutters into operation.

Finishing the Banjo Faces of the Rear-Axle Housing

The banjo faces of the rear-axle housing are finished one at a time on the machine shown in Fig. 1, which is equipped with a cutter-head having nine inserted blades positioned around a flat face. With the work loaded in the fixture, the cutter-head is fed downward by hydraulic pressure to a positive stop which controls the height of the finished banjo face above the center line of the axle housing. A pilot on the cutter-head enters a bushing in the center of the fixture for accurately guiding the cutter-head. The work is located by clamping a finish-turned cylindrical surface on the ends of the housing in vees of the fixture and resting the banjo face opposite the one being machined on a hardened and ground bar.

Fig. 4. Indexing Type of Machine that Drills and Taps Holes in Rear-axle Housings, Threads Axle Ends, and Cuts a Keyway across Threaded Surfaces



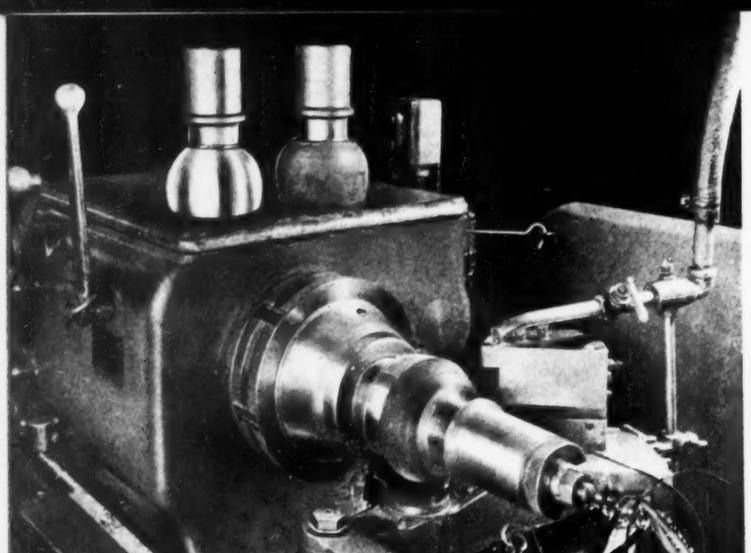


Fig. 5. Automatic Lathe Tooled up for Turning a Spherical Surface on Steel Trunnion Sockets, a Deep Cut being Taken with a Tungsten-carbide Tool

When one banjo face has been milled, the housing is lifted from the vees and slid along rails extending to the front of the machine until it is sufficiently clear of the cutter to permit the banjo to be revolved through 180 degrees. The housing is then replaced in the fixture for milling the second banjo face. The tolerance on the height from a center line passing through the machined axles to the banjo faces is 0.010 inch.

Grinding Wheel-Bearing Seats to Close Limits on a Centerless Grinding Machine

The next operation on the rear-axle housing consists of grinding two wheel-bearing seats and an oil sealing surface on both axle ends of the housings. This operation is performed, one end at a time, in the centerless grinding machine illustrated in Fig. 3, which is equipped with two grinding wheels and with two regulating wheels that provide the necessary pressure against the work for the performance of the operation. One of the grinding wheels is stepped, so as to grind a bearing seat and the oil seal. The other grinding wheel finishes one surface only. The total tolerance on the bearing-seat diameters is 0.0007 inch, and on the oil seal 0.003 inch.

For this operation, the axles of the housing are seated on roller rests of a fixture, one end of which extends between the grinding and regulating wheels. In order to insure the smoothness of rotation essential to accurate grinding, weight bars are clamped on the opposite banjo faces, as seen in the illustration. These bars serve as counterbalances to compensate for the large banjo opening.

Special Machine Used for Drilling, Milling, and Threading Rear-Axle Housings

In Fig. 4 is shown a large machine of special construction, designed for performing a number of operations on rear-axle housings for 1 1/2- and 2-ton trucks. From the loading position at the front of the machine, the work is indexed downward 90 degrees to a bottom station, where a multiple-spindle head feeds in from the left to drill all the holes in one of the wheel flanges. The housing is then indexed to a third position at the back of the machine, where a horizontal head slides in at right angles to the housing for drilling fourteen holes around one of the banjo faces. At the same time, a head at the left-hand side of the machine advances a small circular milling cutter for cutting a keyway along the end of the cylindrical surface on the axle. Finally, in the fourth station, at the top of the machine, the holes drilled in the banjo in the third station are tapped by the spindles of a multiple head mounted vertically on the upper cross-bracket of the machine. At the same time, threads are cut on the end of the axle by a die-head equipped with circular chasers, which is fed in from the left.

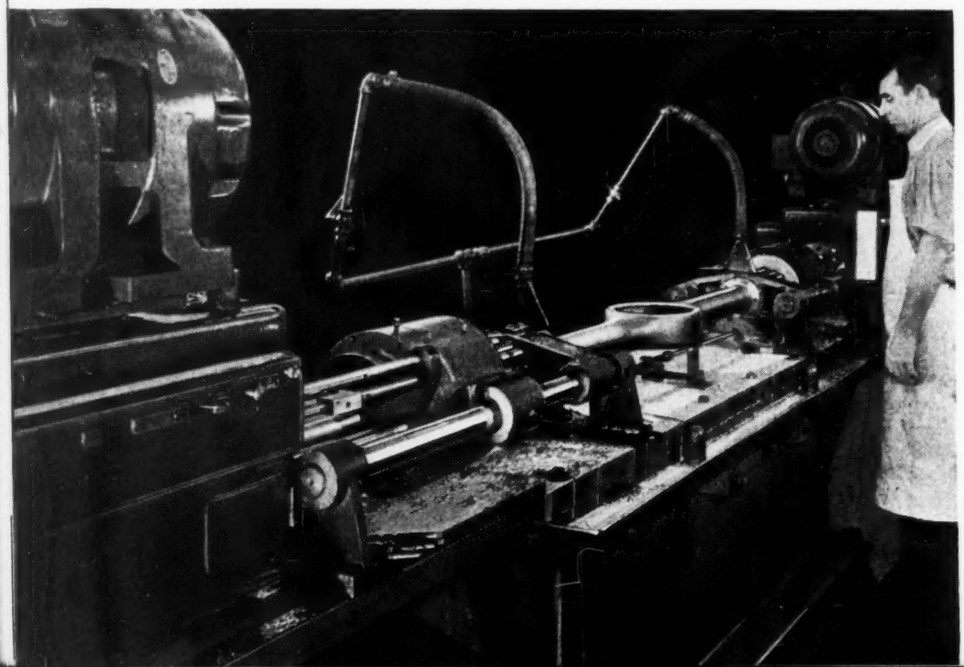


Fig. 6. Two-way Machine Employed for Simultaneously Drilling all of the Holes in Wheel Flanges of Rear-axle Housings for 1/2- and 1-ton Trucks

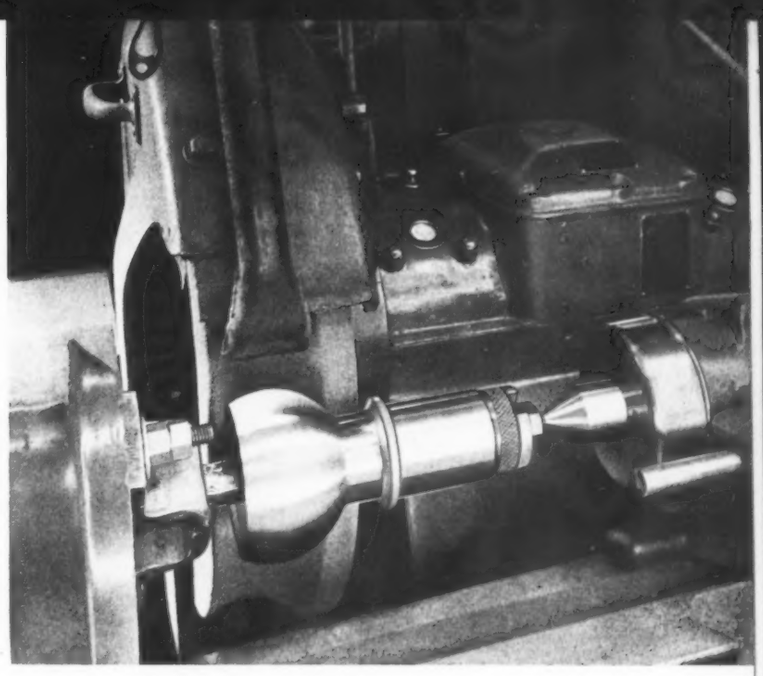


Fig. 7. Form-grinding the Spherical Trunnion Socket after a Normalizing Treatment, as Well as the Neck in Back of the Spherical Portion

When one end of the housing and one banjo face have been machined as described, the axle housing is turned end for end while in the loading station of the fixture for a second passage around the machine, during which the opposite axle and banjo face are machined. From the illustration it will be seen that the housing is adequately supported at both axles, and accurately located both from the axles and the banjo face opposite the one being machined.

Drilling Wheel Flanges on a Double-Head Machine

Both wheel flanges on the rear-axle housings for 1/2- and 1-ton Dodge Army trucks are drilled simultaneously by the use of the hydraulically actuated double-end machine shown in Fig. 6. There are multiple-spindle drill heads at the opposite ends of this machine, which move forward and backward on guide bars extending along the machine bed on both sides. A bushing-holder mounted on the same guide bars is advanced ahead of each drill head until a sleeve in the center of the bushing-holder engages one of the previously ground bearing seats of the housing axle. This insures accurate positioning of all drill bushings relative to the center line of the housing.

At the beginning of the operation, a rod that extends to the middle of the bed raises equalized fingers upward into contact with the finished bottom banjo face to provide adequate support for the housing on both sides of the banjo. The drill heads and bushing-holders are returned automatically to their starting positions at the end of the operation.

Some of the most unusual jobs in machining parts for Dodge Army trucks are performed on the spherical trunnion sockets that are assembled into the ends of the front axles for "quad" drives. These trunnion sockets are machined to a true sphere in automatic lathes tooled up as shown in Fig. 5, after the shank end has been finish-turned, as seen on the piece at the right on top of the headstock.

For the spherical turning operation, the workpiece is slipped on a stub-arbor attached to the headstock spindle. The turning tool is mounted at the rear of the machine on a holder that is pivoted below the center of the trunnion socket. This holder is swung around its pivot, with the tool positioned to finish the socket to the required radius, as the machine carriage is fed along the bed. The pivoting action is produced by a link which is attached to the left-hand end of the carriage and to one end of the pivoted tool arm. A cut from 1/4 to 5/16 inch deep is taken with a tungsten-carbide tipped tool.

After the turning operation, the trunnion sockets are normalized and are then transferred to the grinding machine shown in Fig. 7, which is equipped with a form wheel for grinding the socket to a true sphere within close limits and for grind-

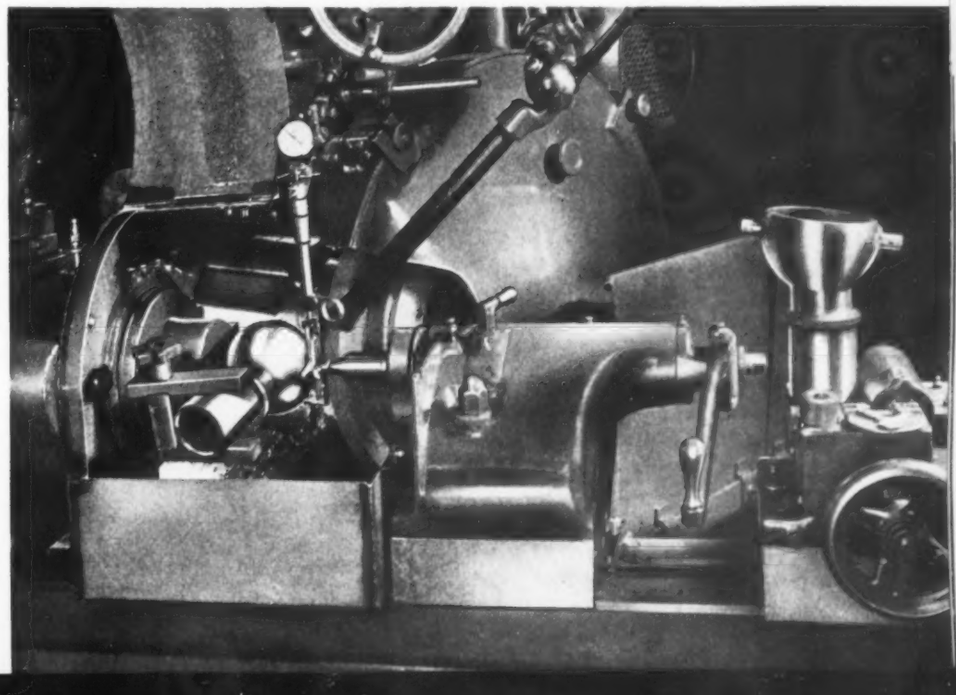


Fig. 8. Machine Used for Grinding the Pins Assembled in the Walls of the Trunnion Socket and a Shoulder at Right Angles to Each Pin

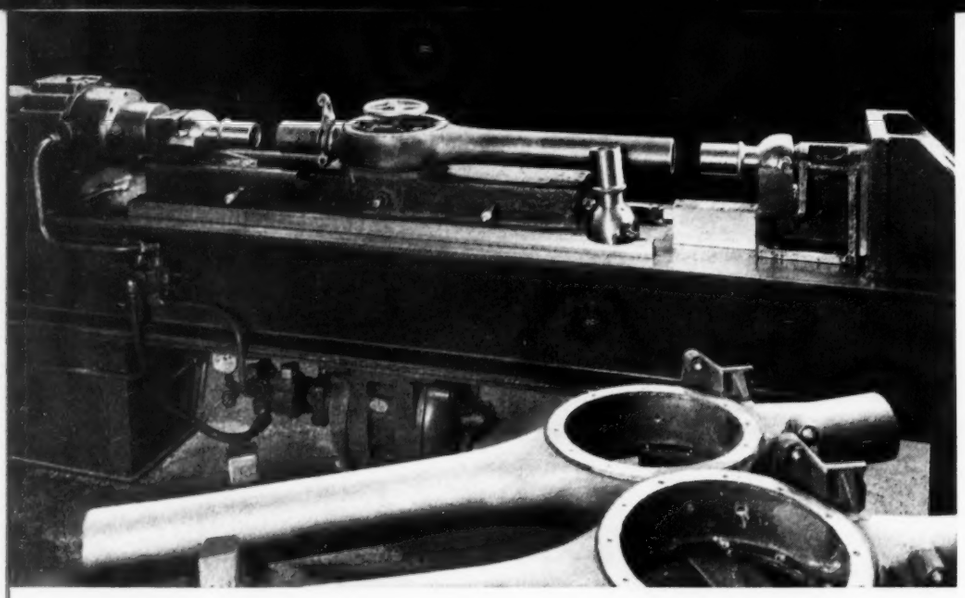


Fig. 9. Hydraulically Actuated Horizontal Press Employed for Assembling the Trunnion Sockets to the Ends of Front-axle Housings

ing the cylindrical neck in back of the spherical surface. The socket is mounted on an arbor for this operation also, so that it can be supported between the centers of the headstock and tailstock. The grinding wheel feeds straight in, and removes from 0.015 to 0.020 inch of stock on the diameter. The tolerance is 0.005 inch, the specified spherical diameter being 5.135 to 5.140 inches. The grinding wheel is dressed by a device that slides along the same ways as the tailstock. The wheel is 5 inches wide by 28 inches in diameter.

Equipment Used for Grinding Pins on Trunnion Sockets

After the performance of several other operations, during which trunnion pins are pressed into holes drilled through the socket walls and welded to the sockets, as seen at the right-hand end of the machine in Fig. 8, the parts reach the grinding machine shown in that illustration. This machine is employed for grinding the two trunnion pins to the required diameter and for grinding a shoulder at right angles to each pin. The part is supported from center holes drilled in the trunnion ends. The face of the grinding wheel is dressed to an angle in relation to the center of the wheel-spindle, and it is fed to the work in an angular direction until it reaches a position determined by a dial indicator at the front of the machine.

The specified grinding tolerance is 0.001 inch, but a tolerance of 0.0005 inch is easily maintained. The trunnions are inspected by ring gages. When one of the trunnion pins has been ground, the trunnion socket is turned through 180 degrees to present the second trunnon pin to the grinding wheel, and reclamped. The wheel-dressing device is seen at the right-hand end of the bed.

Assembling Trunnion Sockets to Front-Axle Housings

The trunnion sockets are assembled into the ends of the front-axle housings by the use of the horizontal press shown in Fig. 9 which is equipped at the left-hand end with a hydraulic ram. For this operation, the housing banjo is located by means of clamps which are expanded radially against the inside of the banjo by the application of air pressure. Other clamps are then tightened on the bottom banjo flange by turning a handwheel. One ball trunnion is placed on the front of the hydraulic ram, and another on a rest at the right-hand end of the bed. The hydraulic ram is then operated to push the left-hand trunnion socket into the axle housing and then to force the housing and the two sockets together until they have been assembled. The table slides along the bed with the axle housing. The housing openings

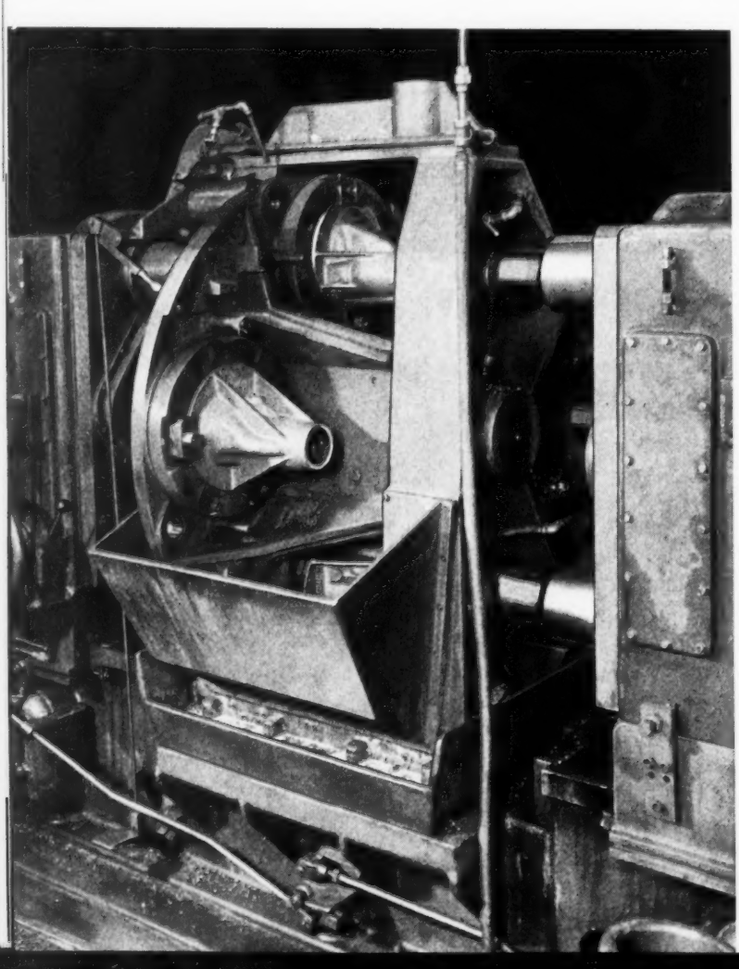


Fig. 10. Two-way Machine Arranged for Rough-, Semi-finish-, and Finish-boring the Outer and Inner Pinion Bores in Differential Carriers

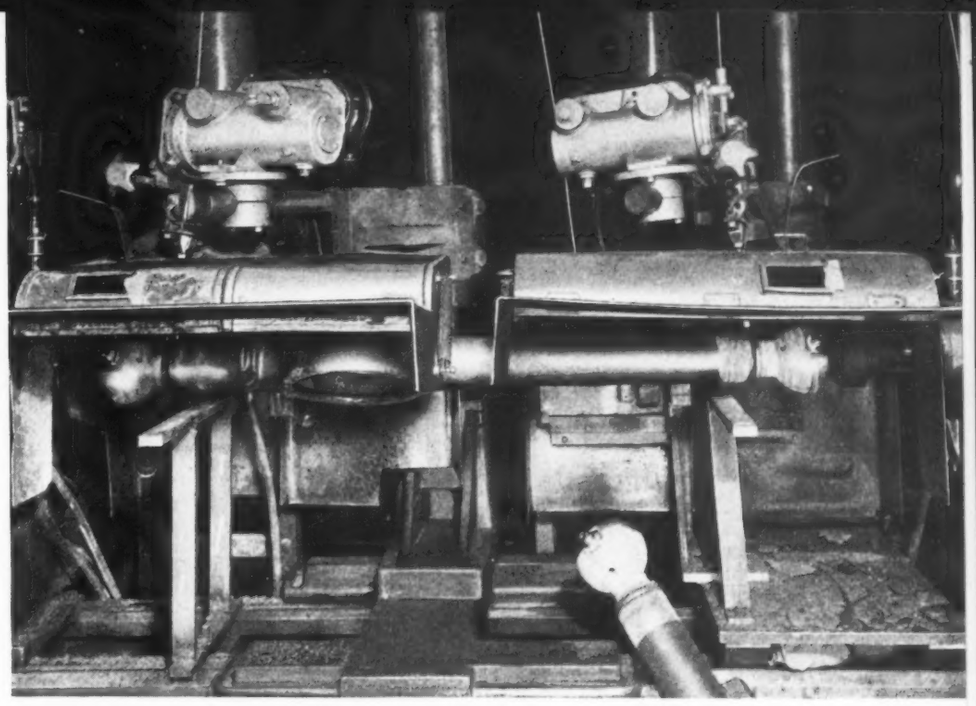


Fig. 11. Machine Equipped with Two Arc-welding Heads for Welding the Trunnion Sockets to the Ends of the Front-axle Housings

into which the trunnion sockets are assembled have been machined prior to this operation.

Welding Trunnion Sockets to Axle Housing on a Double-Head Machine

The groove between the flange on the trunnion socket and the end of the axle housing is filled with weld metal in an arc-welding operation performed in the double-end machine shown in Fig. 11. The two automatic welding heads weld both trunnion sockets simultaneously as the housing assembly is revolved by the headstock of the machine. Electrode wire is fed from coils at the back of the machine up over large overhead sheaves and down to the welding heads.

Boring Differential Carriers on Two-Way Machines with Indexing Fixtures

Fig. 10 shows the pinion bores in differential carriers being machined in a two-way machine equipped with a four-station indexing fixture. The differential carriers are located radially in the different stations of the fixture by seating two holes in the flange over dowels on the fixture and clamping the differential carrier against its finished face.

The first operation, which is performed in the top position of the machine, consists of rough-boring the outer and inner pinion bores from the opposite sides of the machine. The same holes are semi finish-bored in the rear station, and finish-bored in the bottom station. One of the pinion bores is machined to two diameters and to a shoulder, while the other is machined to one diameter and a shoulder. All diameters are held within a tolerance of 0.001 inch, and the tolerance on the alignment of the two bores is extremely close. Inserted-blade boring tools are employed in all stations.

The cross-bores of the differential carriers are finished later in the two-way machine illustrated in Fig. 12, which is also equipped with a four-station indexing fixture. Boring, reaming, and tapping are performed in both bores at the successive stations of the machine. The two bores are offset a slight amount in order to accommodate hypoid gearing. They must be parallel and accurate as to diameter within close limits. The out-of-roundness in relation to the pinion bores must not exceed 0.004 inch at a distance of 14 inches

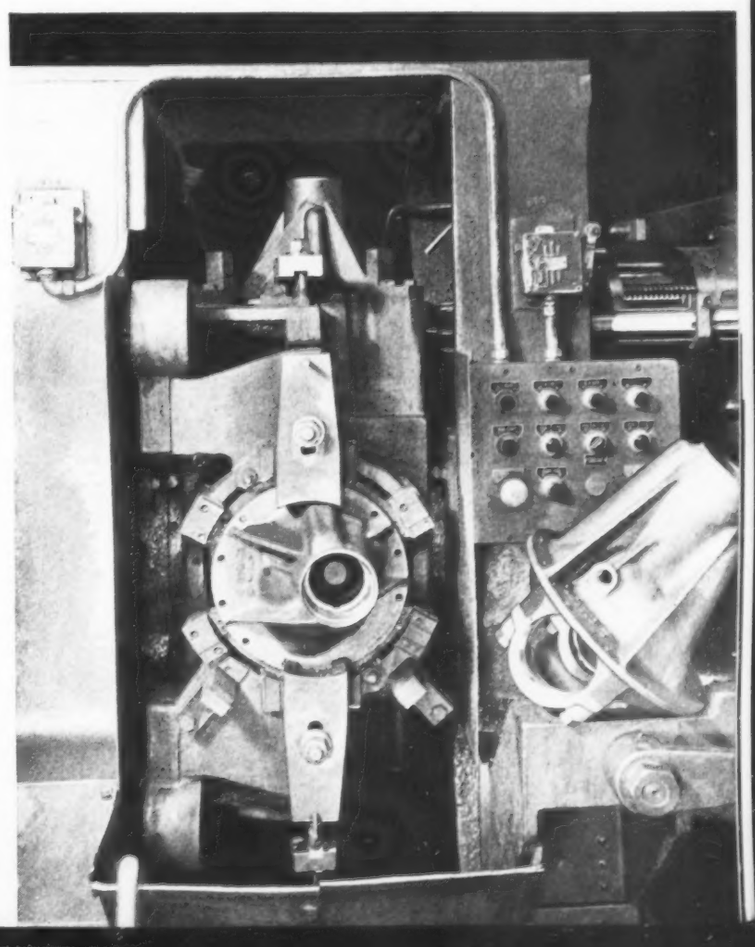


Fig. 12. Two-way Machine Equipped with a Four-station Indexing Fixture for Boring, Reaming, and Tapping Cross-bores of Differential Carriers

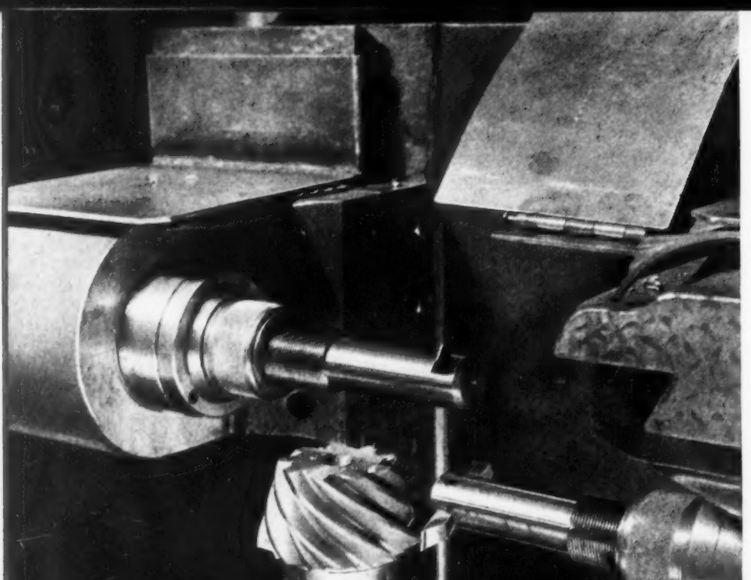


Fig. 13. Chamfering Machine Employed for Removing Burrs from the Upper and Lower Ends of Drive Pinion Teeth

illustration. In Fig. 13 is shown a machine that is employed for removing the burrs from the top and bottom ends of the pinion teeth. Two fly cutters, mounted on separate shafts, remove the burrs as they revolve in synchronism between the teeth of the rotating pinion. Proper location of the pinion teeth in relation to the cutters is insured by the application of a locator at the front of the fixture which is swung upward into engagement with two of the pinion teeth. With the locator in position, the operator depresses a foot-pedal to actuate a hydraulic valve for clamping the pinion securely. The locator is then lowered out of the way. In the operation, the cutter-head feeds forward automatically to bring both cutters into the operating position, and returns when the pinion has completed one revolution.

from the center line of the cross-bores. The differential carriers are located in the different stations of the indexing fixture from the same dowel-holes that were used for locating purposes in the machine that finished the pinion bores.

A general view of the department in which hypoid driving pinions and gears are produced for Army trucks is seen in Fig. 14. There are three roughing and six finishing generators for the pinions, and three roughers and three finishers for the gears. In addition to these gear-tooth generating machines, there are large batteries of lapping and testing machines, which are not seen in the

* * *

Machine Tool Output Rapidly Increasing

The National Machine Tool Builders' Association, 10525 Carnegie Ave., Cleveland, Ohio, announces that the shipments of the machine tool builders who are members of the Association—comprising over 95 per cent of the industry—totaled $52,100,000 in February. Considering that the number of working days in February is smaller than in any other month of the year, the rate at which the industry now works is equivalent to at least $650,000,000 annually, a rate that will be considerably increased when many of the additions now being completed by the machine tool builders are put in operation later in the year.

Fig. 14. Gear-cutting Department which Generates Hypoid Gears and Pinions for Dodge United States Army Trucks

Centerless Grinding of High-Nickel Alloys

By JOHN H. JAECKER, Scarsdale, N. Y.

THIS article describes the changes involved in shifting from hand to machine grinding of bars of Monel, nickel, and Inconel; the problems arising in adapting a centerless grinder to this work; the results obtained from such a machine in the maintenance of close tolerances and a high production rate in producing rounds of good surface; and the removal of an unusually large amount of stock as economically as possible, with little emphasis on the quality of surface obtained.

Before a hot-rolled rod can be cold-drawn through a die, several operations are necessary. One of these is grinding to remove the hot-mill scale and surface imperfections from Monel, nickel, and Inconel. As most imperfections are at least several thousandths inch deep, and the rods are usually in the neighborhood of 0.010 inch out of round as received from the rolling mill, about 0.018 to 0.022 inch of stock must be taken off on the diameter in order to remove all surface imperfections. This operation was done formerly by a battery of five hand-guided, electric swing grinders.

Inspection of the work done by the hand grinders showed that it was so extensive that the ground rod was usually completely skinned. It was therefore concluded that the work could be done by a machine. The machine selected was a No. 3 Cincinnati centerless grinder having a long-bar fixture with roller guides. It has a rated capacity for handling bars from 1/2 inch to 4 inches in diameter and up to 24 feet long. The grinding wheel used is 24 inches in diameter, driven by a 30-H.P. constant-speed motor. The abrasive regulating or feed wheel is 14 inches in diameter, driven by a 1-H.P. constant-speed motor. The rate of feeding the work is controlled by using different sets of gears and by tilting the regulating wheel on an axis which is perpendicular to the axis of the bar being ground. The grinder needs no foundation, and occupies a floor space of 7 by 7 feet, but sufficient room must be available at both ends of the machine for the ingoing and outcoming bars of a maximum length of 24 feet.

The grinding and regulating wheel faces are kept in condition by diamond truing tools which are set into the machine. The grinding-wheel truing tool is hydraulically operated, and the regulating-wheel truing tool manually operated. The rod being ground is kept cool and clean by a solution of 10 per cent water-soluble oil in 90 per cent water, which is circulated by a motor-driven pump. The work is supported between the grinding wheels by a guide blade, the height of which is adjustable for different sizes of rods.

The problems encountered in removing a large amount of stock from bars of Monel, nickel, and Inconel arose entirely from the characteristics of the metals. The following table gives these characteristics:

Alloy	Chemical Analysis, Per Cent	Tensile Strength, Pounds per Square Inch
Monel	65-70 nickel 26-30 copper	80,000- 95,000
Nickel	98 nickel	70,000- 85,000
Inconel	80 nickel 12 chromium 6 iron	95,000-105,000

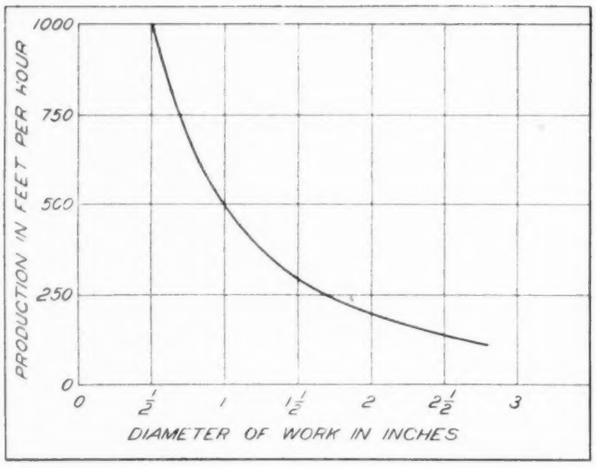
These high tensile strengths, together with the high degree of toughness associated with these alloys, caused three major operating difficulties: (1) Severe metal pick-up on the guide blade; (2) rapid breaking down of the face of the grinding wheel; and (3) excessive power requirement.

How the Metal Pick-Up was Handled

The metal pick-up on the guide blade was so severe that the rods being ground had deep spiral grooves cut in them, much like a screw thread. This condition was particularly accentuated when using either soft gray iron or the hard Meehanite iron blades regularly furnished with the grinder. In order to get the grinder into operation without too much delay, hard wood blades were used at first until a more suitable material could be found. After the trial of many steels, fibers, and brasses, an alloy called Ampco Grade 21, made by Ampco Metals, Inc., was found to give the most satisfactory results. Its chemical composition is as follows: Copper, 82.3 per cent; aluminum, 13.1 per cent; iron, 4.1 per cent; and other metals, 0.5 per cent.

This alloy has a large grain, is very brittle, and is almost impossible to machine. Attempts to weld or bolt wearing strips of it on steel blades were only partially successful. For these reasons, the blades were purchased as castings and ground to size. As the blade wears, it can be shimmed up, in addition to the usual adjustment for height which is provided for in the design of the grinder. In order to minimize wear of the blade, all grinding is done with the center of the work above a line joining the center lines of the grinding and regulating wheels.

It should be mentioned that a 6 per cent carbon, cast-iron blade was also tried out. This gave good operating performance, but casting and machining difficulties were too numerous to warrant further experimentation at the time.



Curve Showing Production Obtained when Grinding Hot-rolled and Straightened Monel, Nickel, and Inconel Rods on a Centerless Grinding Machine

The grinding wheel must have an unusual combination of properties. Its grit must be sufficiently hard and tough to remove 0.020 inch from the diameter of the bar while the work is fed through at a high rate of speed. The bond must hold the grit tightly enough so that the particles of abrasive are not pulled loose before they have lost their useful, metal-cutting properties. At the same time, the bond must be of such a nature as to release the grit fast enough to prevent the grinding wheel from becoming loaded with metal, but not so hard that the grit will lose its cutting power and cause the wheel to glaze.

The starting diameter of the grinding wheel is 24 inches, and the finishing diameter 16 inches. This great difference in size during its life results in a large variation in both the surface speed and the arc of contact with the work. The grinding wheel must not glaze when it is in its large size nor must it become loaded with metal as it wears down to its minimum diameter. The surface speed of the grinding wheel as it wears decreases from 6000 to 4700 feet per minute. The combination of gears possible in the regulating wheel train, together with all the angle settings available for the regulating wheel, permits a work speed variation of from 25 to 50 feet per minute. This range of grinding wheel speeds and work speeds is within the limits recommended by W. F. Burchfield in "Metals Handbook," for grinding high-nickel alloys. The difference in the surface of the ground rods is not great enough to be objectionable, as all of them are processed further. They will ultimately have identical surfaces.

The manufacturers of grinding wheels were faced with an entirely new problem, so much so that the first wheels recommended for the job literally disintegrated when used. After many trials, the following two makes and grades of grinding wheels combined the necessary cutting characteristics together with a satisfactory life: Macklin Co., grade 36-10G11; and Carborundum Co., grade 36K-6-C4. The grinding wheels in both cases have silicon-carbide grit and a resinoid bond. These wheels give practically identical results, and have a life of sixty grinding hours, even when used down to a diameter of 16 inches.

Power Requirements and Production

An overloaded motor condition arose in the operation of the grinder. It was dealt with by not feeding the rods into the machine any faster than they could be handled without overloading the 30-H.P. main-drive motor. The full rated load on the drive motor is 75 amperes, which was recorded by an ammeter connected in the wiring to the motor. Although the motor can be loaded beyond this amount, it was decided not to attempt to do so, in order to avoid overheating the motor. The load is constant, as one bar follows immediately behind the other. The grinder is operated at full load when removing the required amount of stock from a 1 7/16-inch diameter rod at the rate of 300 feet per hour. The largest rods ground are 2 3/8 inches in diameter. The grinding of larger rods was not attempted for various production reasons. All rods, therefore, from 1 1/2 to 2 3/8 inches in diameter, inclusive, are given two passes through the grinder, removing 0.010 inch at each pass.

As operating conditions are now established, the production of the No. 3 Cincinnati centerless grinder approximates the curve shown in the accompanying diagram, with slight modifications due to the time lost in changes of set-up.

The production indicated by the curve is the maximum obtainable under the present operating conditions. It represents the work formerly done by five men with hand grinders; and the ground surface obtained with the centerless grinder is superior to the hand-ground surface. The superiority is due to a greater uniformity in the grinding operation, which makes it possible to eliminate several steps in the subsequent processing of a number of the small sizes of rods.

The largest single item in the cost of operating the grinder is the grinding wheel cost of $90 for sixty operating hours. This cost is less than the wheel cost of the five hand grinders which formerly did the work. One man operates the grinder, with time to spare. If it were not for the time required to change set-ups and grinding wheels, one man could easily operate two such grinders. The time required for change of set-up is 40 minutes; and for changing the grinding wheel, 1 hour, with the use of a crane.

The following improvements may be feasible. A different grinding wheel may be developed that will have a longer life and decrease the cost of grinding; or a new wheel may result in the use of less power and thereby allow increased production without any additional load on the motor. As the wear on the blade is severe, resulting in short blade life, the substitution of some inexpensive iron guide blade would effect additional economies.

Unusual Methods Employed in Producing Hamilton Propellers

Automatic and Semi-Automatic Machines Operated by Semi-Skilled Labor Turn out Even More Accurate Propellers than the Standard Machines and Skilled Labor of Past Years

By ARVID NELSON, Factory Manager
Hamilton Standard Propellers Division
United Aircraft Corporation

THE production advantages of automatic and semi-automatic machine tools in the aircraft industry were described in an article in July, 1940, MACHINERY, page 152. This article deals with additional operations performed in the factory of Hamilton Standard Propellers, East Hartford, Conn., on machines of completely special design or specially equipped to give an output consistent with present-day requirements.

The extent to which automatic equipment is used in making airplane parts in this propeller plant is indicated by the fact that there are seven Bullard Mult-Au-Matics in use there. One of these machines, of eight-station design, is illustrated in Fig. 1 tooled up for drilling and turning the three arms of Hydromatic spiders, as well as for facing the shim-plate seat at the inner and outer ends of each arm. The spiders are indexed three times around the machine, once for each arm. As the spiders return to the loading station after the first and second trips, they are indexed 120 degrees on their axes to bring another arm into the vertical or operating position.

In the first working station of this machine, which is seen at the left in the illustration, the end of a spider arm and the shim-plate seat are faced

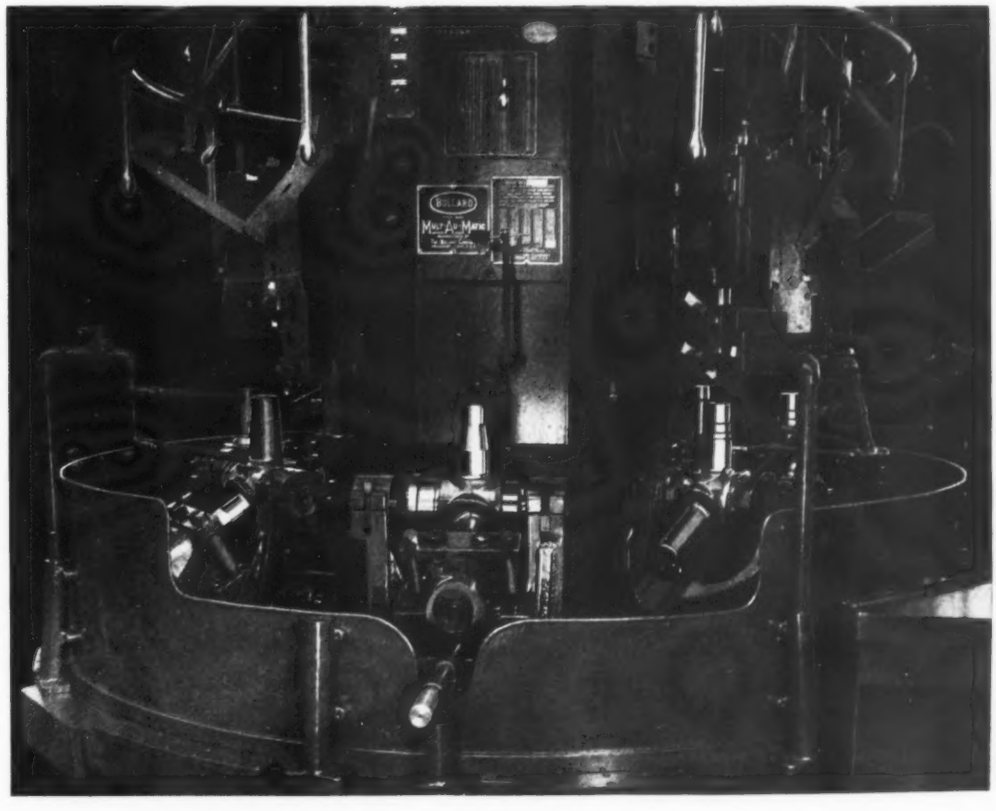


Fig. 1. Eight-station Mult-Au-Matic Tooled up for Drilling, Boring, and Turning the Three Arms on Propeller Spiders

★

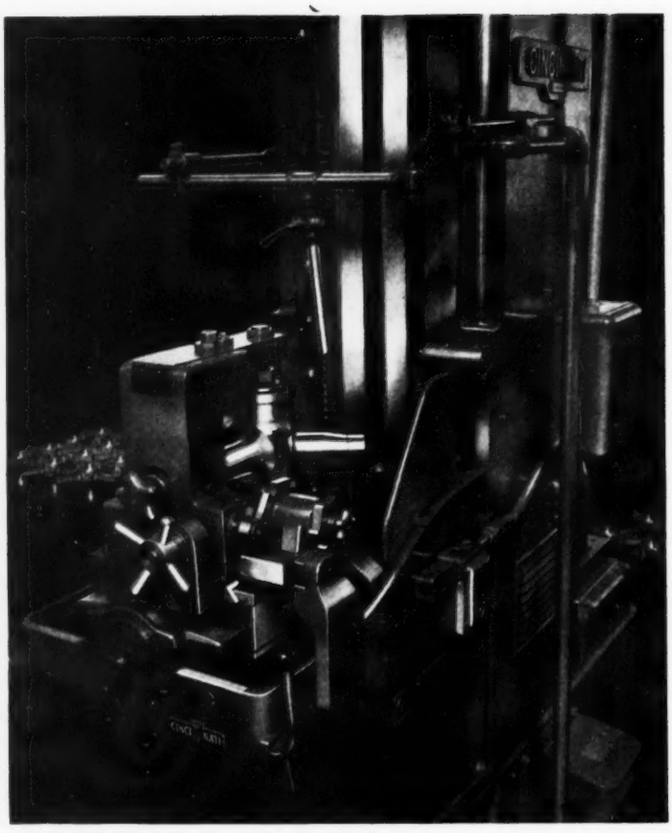


Fig. 2. (Above) Broaching Operation which Produces Slots between the Spider Arms by Six Passes of the Broach through Each Slot

Fig. 3. (Below Left) Milling Machine with Cam-actuated Tool-heads, which is Employed for Milling Twelve Bolt Lugs on Propeller Barrel Halves

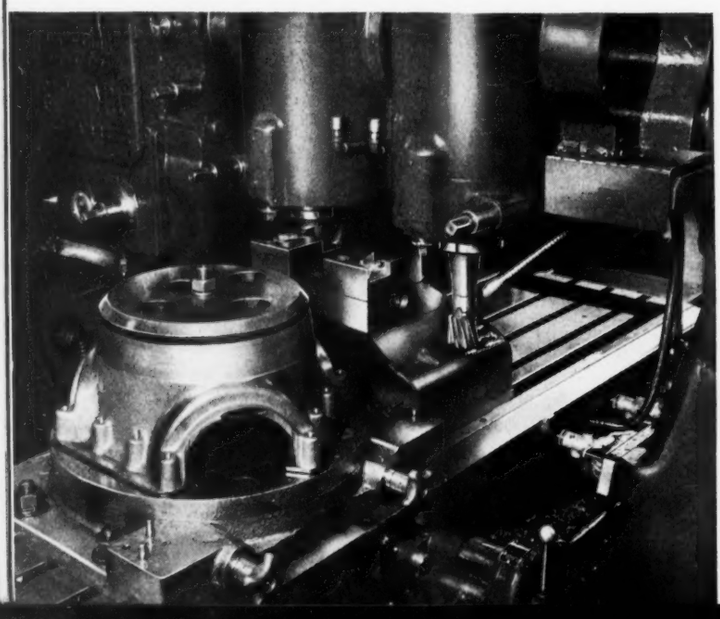
Fig. 4. (Below Right) Oil-grooves are Milled around the Three Joint Faces of Front and Rear Barrel Halves by the Use of a Keller Automatic Tool-room Machine Equipped as Illustrated

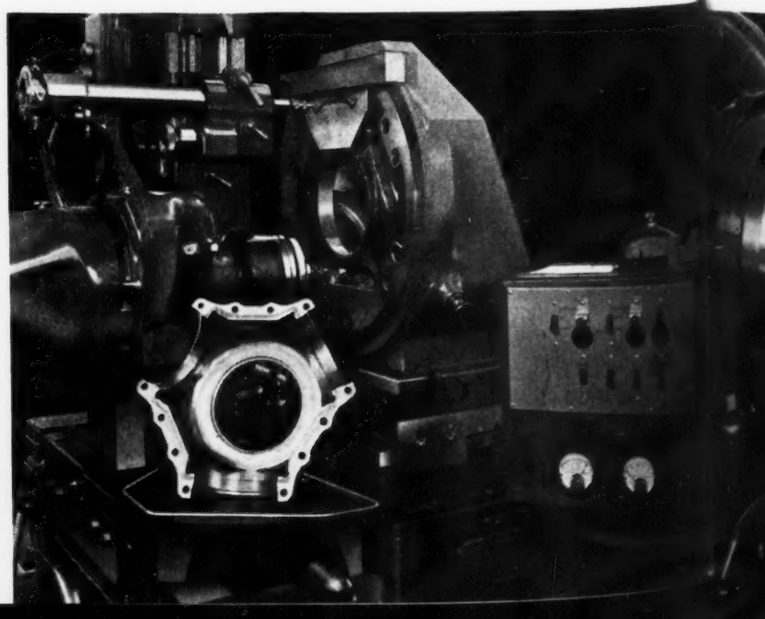
by cutters on a tool-head that is fed horizontally after it is moved downward to the required position. In the second working station, the arm is drilled and is turned at the upper end by two tools, one on each side of the drill. In the third working station, a drill is advanced further into the arm at the same time that cutters on both sides of the drill turn two bearing surfaces and a fillet adjacent to the shim-plate seat.

Drilling of the arm is completed in the fourth working station, where the largest bearing diameter is also turned. The hole is bored the full length and chamfered in the fifth station, and it is reamed in the sixth station, at the same time that another turning cut is taken on the fillet adjacent to the shim-plate seat. Finally, in the seventh working station, the hole is finish-bored, and at the same time, the bearing surfaces are finish-turned. The outer end of the arm is also beveled. This machine has replaced four other machines of different design, and finishes spiders in one-fifth the time previously required.

A unique broaching operation is performed on Hydromatic spiders to provide slots between the three arms for Micarta barrel supports. The operation is performed on the Cincinnati Hydro-Broach shown in Fig. 2 with six rapid passes of the broach, the work being advanced toward the broach between each stroke. The slots are about 1 1/4 inches wide, and are 5/8 inch deep at the maximum point. The broach is about 4 feet in length, and is made with a long series of teeth that cut on the top only, followed by finishing teeth that cut on the sides of the slots as well as on top.

The spider is advanced predetermined amounts toward the broach between successive strokes through the action of a cam on the right-hand side of the fixture base which is in contact with a roller on the fixture. The cam is made with six lands of gradually in-





creasing radii. Therefore by indexing the cam the work is advanced in desired increments between the strokes of the broach. When one of the slots has been finished, the spider is indexed through 120 degrees and the cycle repeated for broaching the second slot. This procedure is repeated again for machining the third slot.

An unusual milling operation is involved in finishing the bolt lugs on the barrel halves for Hydromatic propellers. This operation is performed on the Sundstrand Hydro Screw Rigidmil shown in Fig. 3, which is equipped with two vertical milling heads. These heads are fed sidewise on an over-arm, each head milling two bolt lugs at different distances from the center of the forging when the work is fed to the cutters. The sidewise feeding movement is accomplished by hexagonal-head studs that project downward from the tool-heads and engage two adjustable cams mounted on a base in front of the work fixture. When the table returns to the front of the machine for indexing the work fixture, the tool-heads are again pulled into their starting positions by two air cylinders. As two bolt lugs are milled by each cutter with every feeding movement of the table, the twelve bolt lugs are milled in three indexings of the work.

Three odd-shaped oil-seal grooves are milled on the joint faces of both the front and rear propeller barrel halves by means of the Keller automatic tool-room machine shown in Fig. 4. The barrel forging is mounted on the back of the fixture, and the small-diameter milling tool is applied to the work through slots in the fixture, as shown. The fixture is indexed to bring the three surfaces to be grooved successively into line with the cutter. The cutter is guided electrically through its irregular path as a stylus at the top of the machine follows a master slot in a templet.

Equipment used for milling the faces on

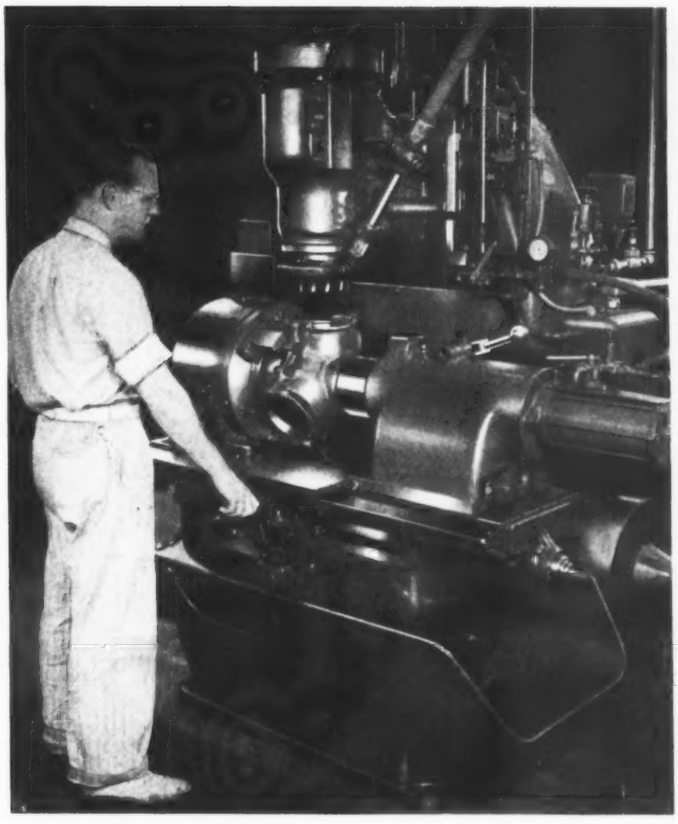
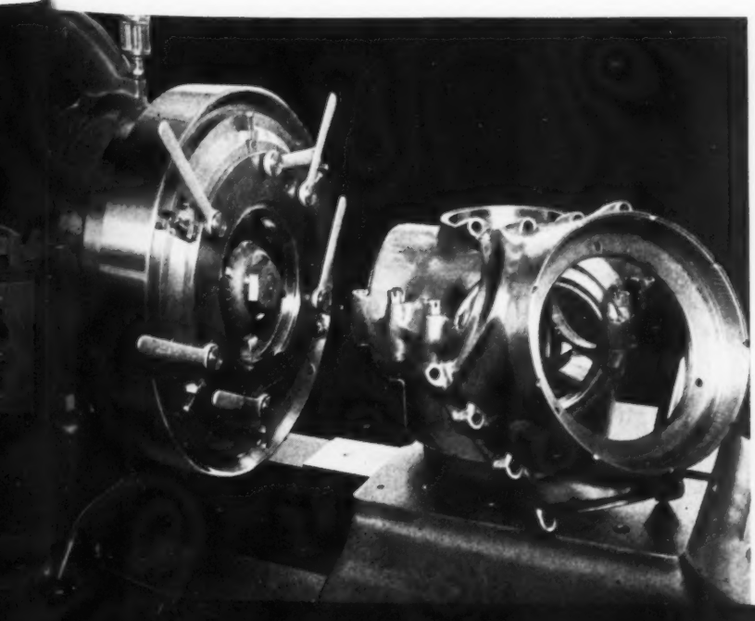
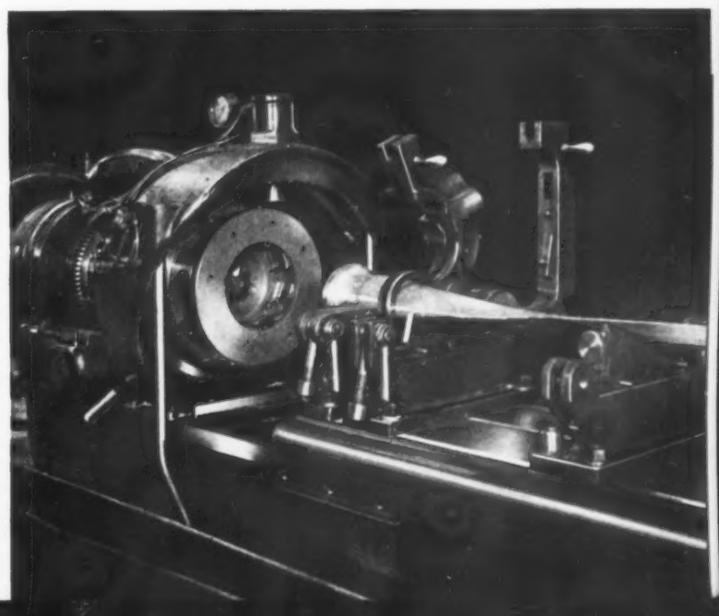


Fig. 5. (Above) In Milling the Arm Faces of Propeller Barrels, as Here Shown, the Work is Clamped by a Hydraulic Cylinder and Ram

Fig. 6. (Below Left) The Threads around the Arm Bores of the Propeller Barrels are Produced on This Planathreading Machine

Fig. 7. (Below Right) The First Operation on Hydromatic Propeller Blades Consists of Form-milling and Facing the Shank End in a Planamilling Machine Tooled up as Illustrated





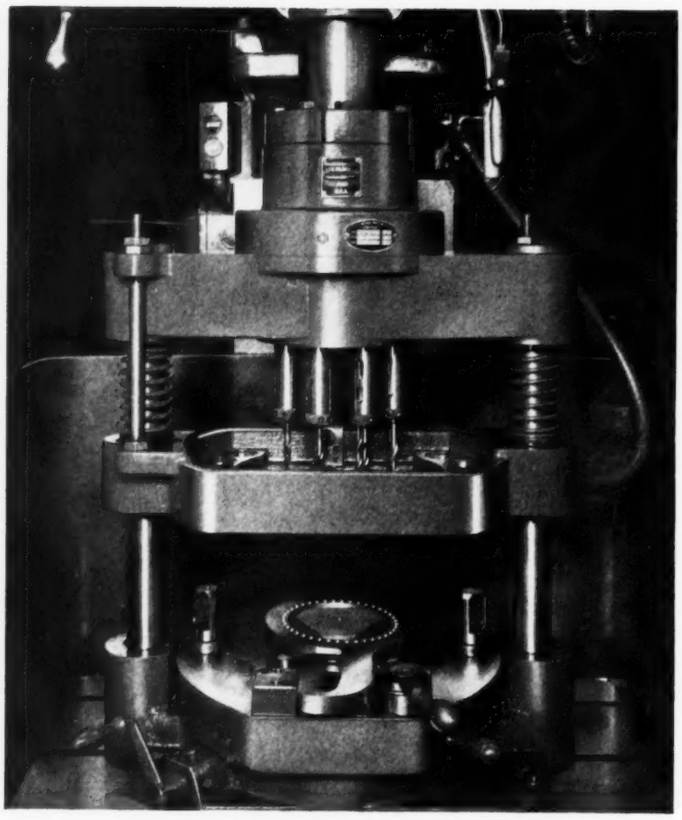


Fig. 8. Equipment Employed for Drilling the Forty Holes Required around Counterweight Brackets, Eight at a Time

the three arms of propeller barrels is shown in Fig. 5. Reamed bolt holes in the barrel are positioned on dowel-pins projecting from the fixture for locating purposes. At the right-hand end of the table is a hydraulic cylinder which advances a ram against the opposite end of the barrel for clamping the work firmly on the fixture. After the cutter has been lowered to the required depth, the machine table feeds both to the right and left for milling the two sides of the barrel faces. Between table movements the work is indexed for milling all three arms. The machine used for this operation is a Sundstrand Rigidmil.

Threads are milled around the inside of the barrel arms on the Hall Planathreading machine illustrated in Fig. 6. Each arm of a barrel is successively clamped against the faceplate of this machine by manipulating six levers which actuate sliding clamps. The thread is cut in each arm by one revolution of the 3-inch diameter cutter eccentrically around the bore. The thread is approximately 6 inches in diameter.

The operation shown in Fig. 7 consists of machining the shank end of propeller blades on a Hall Planamilling machine. This operation, which is the first performed on the blade forgings, involves the use of a series of form cutters that form the flange at the shank end of the blade, as well as the large fillet on the inside of the flange. At the same time, a cutter in the center of the tool-head faces the flange. Both the solid cutter and the inserted form cutters are off center with relation to the work, and they complete the facing and turning in one revolution of the cutters and without any sidewise movement of either the cutters or the work. The work, of course, remains stationary in the conventional manner.

An operation that has greatly expedited production by cutting down the machine time is shown in Fig. 8. It consists of drilling forty holes of 5/16 inch diameter, eight at a time, around counterweight brackets. A single-spindle drilling machine, built by the Barnes Drill Co., performs the operation in about one-tenth the time previously required when only one hole was drilled at a time.

The fixture is designed for easy indexing of the work between downward movements of the drill head. Accurate location in each indexed position is insured by the engagement of two guide posts on the fixture with a series of five bushings on each side of the overhead bushing plate. The work-piece is located in the fixture by a large plug with three contact surfaces which fit the bore of the work, and the part is seated on hardened and ground plugs and pads.

Eight holes are drilled and reamed in gear segments by means of the two multiple-spindle heads provided on the Natco machine shown in Fig. 10, which is equipped with a three-station fixture. The gear segments are indexed to the left from the

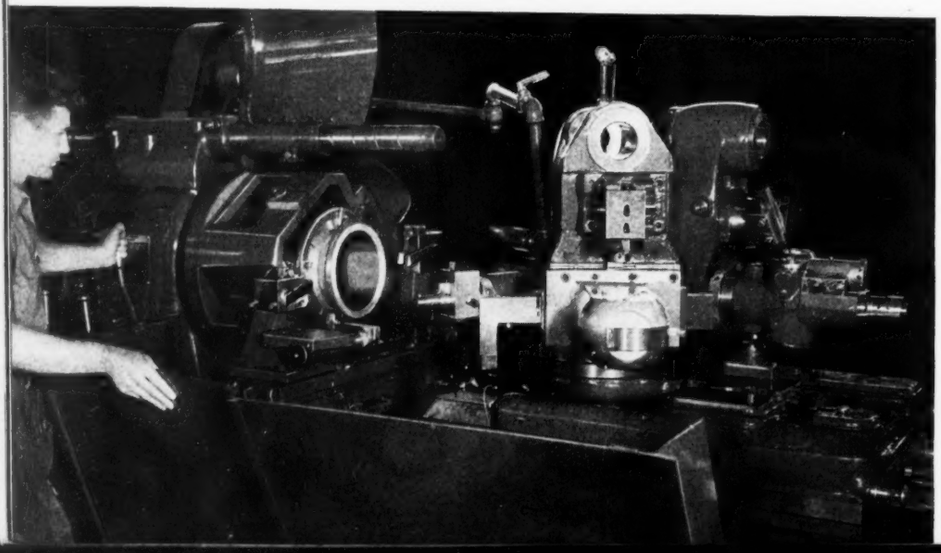


Fig. 9. Domes for Hydromatic Propellers are Machined Both on the Inside and Outside by Means of This Chucking Automatic

loading station for the drilling operation, and then around the back of the fixture to the right for reaming. The holes are drilled and reamed to a flat bottom. The entire operation is automatic, except for indexing of the work.

The domes for Hydromatic propellers are turned, bored, and faced on a Potter & Johnston chucking automatic. One of the outstanding features of this machine, which is shown in Fig. 9, is the cradle type chuck, by means of which both the inside and outside of the domes can be machined in one loading of the work. After the inside has been machined, the dome is turned through 180 degrees to bring the closed end of the work into the operating position, by merely rotating the cradle. The six-station turret is equipped with tools for performing boring and turning operations. Tools at the front and back of the cross-slide take facing cuts. Not only is the straight inside wall of the dome bored in this operation, but also the spherical interior.

Another Potter & Johnston chucking automatic tooled up for taking a large number of boring, turning, and facing cuts on propeller pistons is shown in Fig. 11. Tools are provided on all sides of the six-station turret.

What is considered the most accurate job in this propeller factory is the boring of two internal bearing diameters in the bronze bushing of propeller blades to within plus or minus 0.0001 inch of the specified sizes. This operation is performed in the Heald Bore-Matic shown in Fig. 12, which is equipped with a boring-bar having two cutters. First the front end of the boring-bar is piloted in a bushing in the headstock for boring the smaller diameter bearing, and then another section of the boring-bar is piloted in this bearing while the second tool bores the larger bearing. The boring of the first bearing is completed before boring commences on the larger bearing, this practice being followed in order to maintain accurate alignment between the two bores. Two boring spindles and a double fixture are provided on the machine for handling two different sizes of blade bushings.

Another installation of interest is the Hanson-Van Winkle-Munning cadmium-plating equipment shown in Fig. 13. This equipment is arranged for handling fifteen to twenty different parts, including propeller barrels, spiders, and counterweights. The parts are automatically immersed in a series of cleaning and rinsing tanks along the front side of the unit, after which they are carried through a long plating bath and additional rinse, cleaning, and oil tanks along the rear side.

The work-pieces are suspended from hangers on the ends of long arms that are carried around the machine by link-chain conveyors. All together, there are forty-two of these arms or work-carriers. They are automatically raised as they reach the end of a tank and lowered when they have been trans-

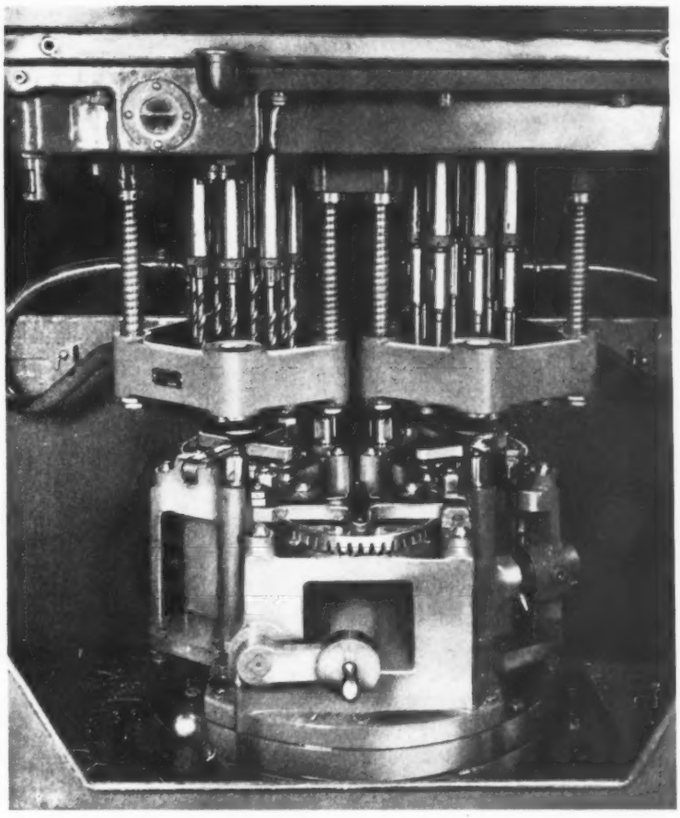


Fig. 10. Multiple-spindle Drilling and Reaming Machine which Finishes Eight Flat-bottom Holes in Gear Segments

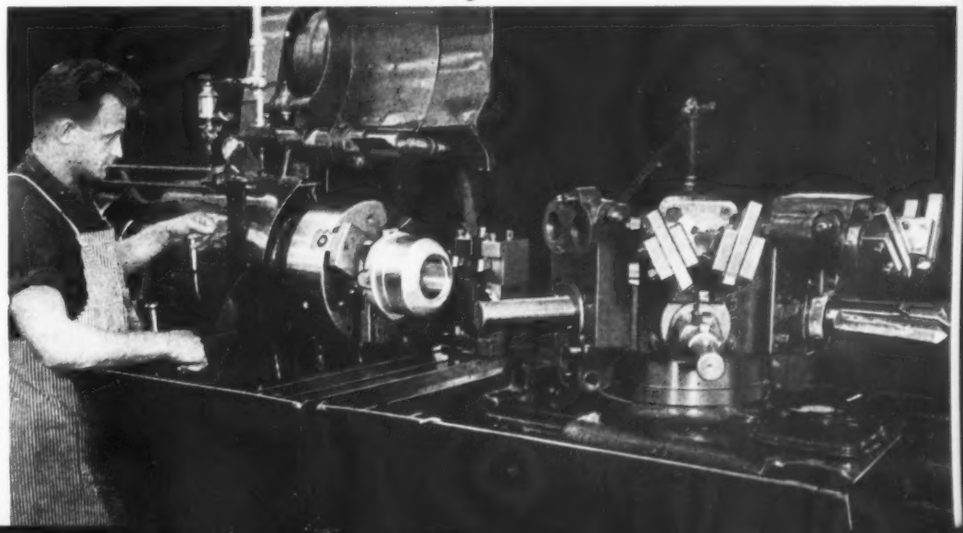


Fig. 11. Another Chucking Automatic Equipped with Tooling for the Boring, Turning, and Facing of Propeller Pistons

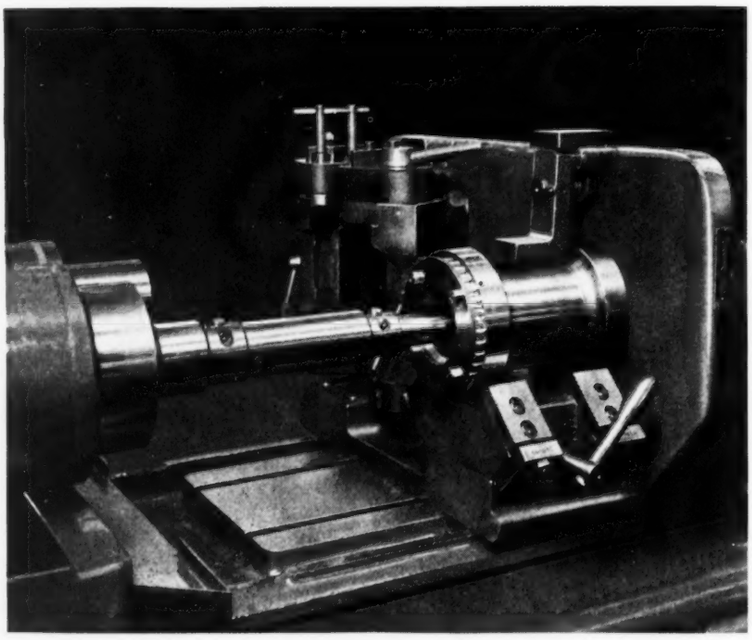


Fig. 12. Precision Boring Operation in which Two Bearings in Blade Bushings are Finished to Close Accuracy with Regard to Both Diameter and Alignment

ferred into position over the succeeding tank. The propeller spiders are plated for the complete length of the main bore, as well as all over the outside, but not on the inside of the arms. To effect this plating, anodes are mounted on the sides of the plating tank and a long anode is also suspended through the main bore of the spider from the carrier bracket. Cadmium to a thickness of about 0.0004 inch is deposited on the various surfaces.

Spectacular Growth of American Manufacturing Industries

A favorable picture of the possibilities for expanding America's manufacturing industries for defense is given in a survey of factory growth during the last four decades, published by the Public Affairs Committee, 30 Rockefeller Plaza, New York City. The survey, entitled *America's Factories*, was summarized by Maxwell S. Stewart from a long-range study of American manufacturing industries made by the National Bureau of Economic Research. It shows that the output of the manufacturing industries here increased by 276 per cent from 1899 to 1937. This is an average increase of 3 1/2 per cent annually, or more than twice the growth in population during that period. The most spectacular gain was made by the automobile industry. Both the machinery and the chemical industries—also vital for defense—made gains far above those of industry as a whole. The industries using the greatest amount of machinery were among those that forged ahead the fastest.

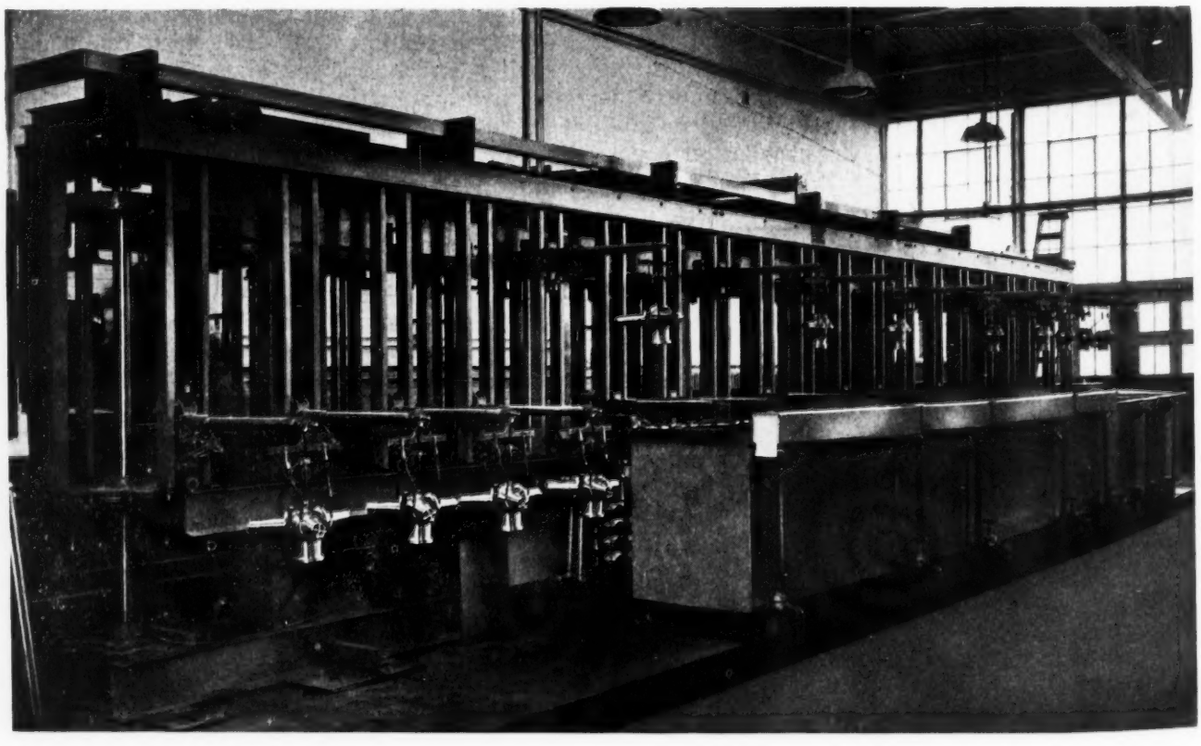


Fig. 13. Cadmium-plating Installation, which is Designed to Handle a Large Variety of Parts

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Rack-and-Pinion Mechanism with Self-Locking Non-Reversing Feature

By L. KASPER

In the operation of a wire-forming machine, it is frequently necessary to change the adjustment of a guide manually. The adjustment must be made quickly and must be maintained without any additional manual locking operation. The rack-and-pinion mechanism shown in Figs. 1 and 2 was designed to provide the required speed and ease of adjustment with the necessary locking feature. With this arrangement, the wire guide can be adjusted in either direction by turning handle *S* in a clockwise or a counter-clockwise direction. The mechanism is automatically locked in position.

Referring to the plan and end views of the arrangement shown in Fig. 1, rack *A* is attached to slide *B*, which carries the wire guide that is to be adjusted. Stud *D*, locked on a stationary part of the machine, carries pinion *C* which meshes with rack *A*. Pinion *C* has grooves in the bore at two points, in which rollers *G*, blocks *H*, and springs *I* are assembled. The grooves in pinion *C* are cut deeper toward one end, so that rollers *G* will be free at the deeper end and will wedge tightly toward the center, forming the conventional type of free-wheeling clutch which permits free movement in one direction and locks or transmits motion in the other direction.

Blocks *H* are backed up by springs *I*, which tend to force rollers *G* toward the shallow end of the grooves, thus insuring a positive wedging action. It will be noted that the wedging action in the two grooves takes place when the driving member is rotated in opposite directions, so that gear *C* is normally locked against rotation in either direction.

Lever *E*, which is free to swing on stud *D* above gear *C*, carries two pins *F* which project into the grooves in gear *C* behind rollers *G*. A slight clearance is provided between pins *F* and rollers *G*, so that lever *E* will have a small amount of free movement. When lever *E* is moved in the direction indicated by the arrow, pin *F* on the left comes in contact with roller *G*, moving it toward the deeper section of the groove in gear *C* and thus eliminating the wedging action on that side. As the wedging action on the opposite side takes place in the opposite direction only, gear *C* is now free to rotate with lever *E*, causing rack *A* and slide *B* to be moved in the direction shown by the arrow.

When lever *E* is released, the wedging action of both rollers *G* again becomes effective in locking pinion *C* against rotation in either direction. As very little movement of rollers *G* is required for effective locking, rack *A* is locked against movement in either direction with almost imperceptible backlash, except when lever *E* is moved.

Stripper Mechanism for Wire-Forming

In the operation of a wire-forming machine, one end of wire *W*—shown in the accompanying diagrams, Figs. 1 to 4—is twisted around a pin, as

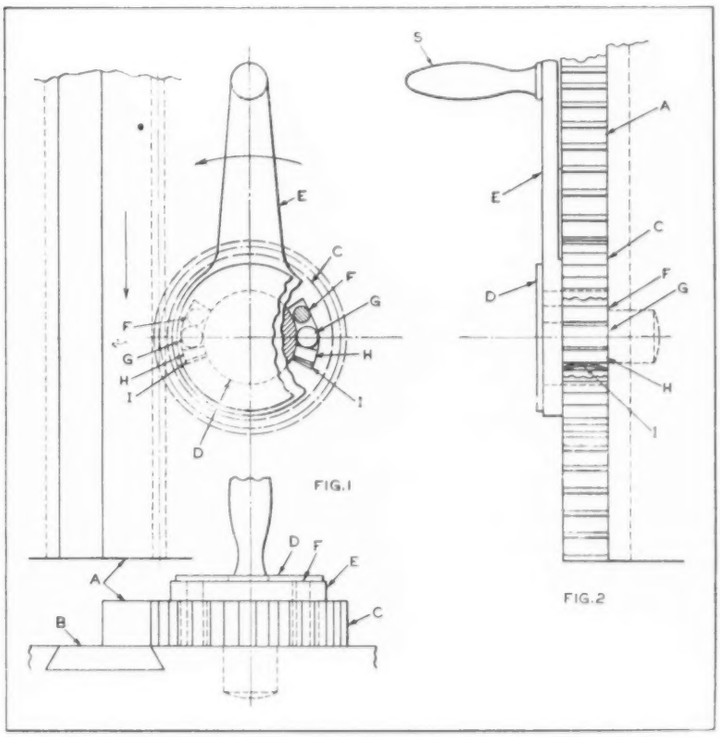


Fig. 1. End and Plan Views of Rack-and-pinion Mechanism with Self-locking Feature. Fig. 2. Side View of Mechanism Shown in Fig. 1

indicated in Fig. 2, and then stripped off the pin in preparation for a subsequent operation. The twisted wire must be held in contact with die-plate *K*, as shown in Fig. 3, for a short time after pin *F* is withdrawn. Stripping fingers *S* must then be raised out of the way after the work has been stripped. The stripping operation is performed by frictionally operated levers in the manner shown by the diagrams.

The diagram Fig. 1 shows the levers immediately before the stripping operation is started. Shaft *A*, supported by bearing *B*, is given an intermittent oscillating motion by a cam (not shown). Shaft *A* is keyed to lever *C*, which carries pin *F* around which wire *W* is twisted. Lever *E* swivels on pin *H*, carried on lever *C*, and is shaped on the free end to form stripping fingers *S*. Lever *D*, which is made of bronze, is split (as shown) to permit it to be clamped around the finished hub extension of bearing *B*, the frictional resistance being adjusted by tension spring *T*. The hole in the outer end of lever *D* is slightly elongated and engages pin *I*, which actuates lever *E*.

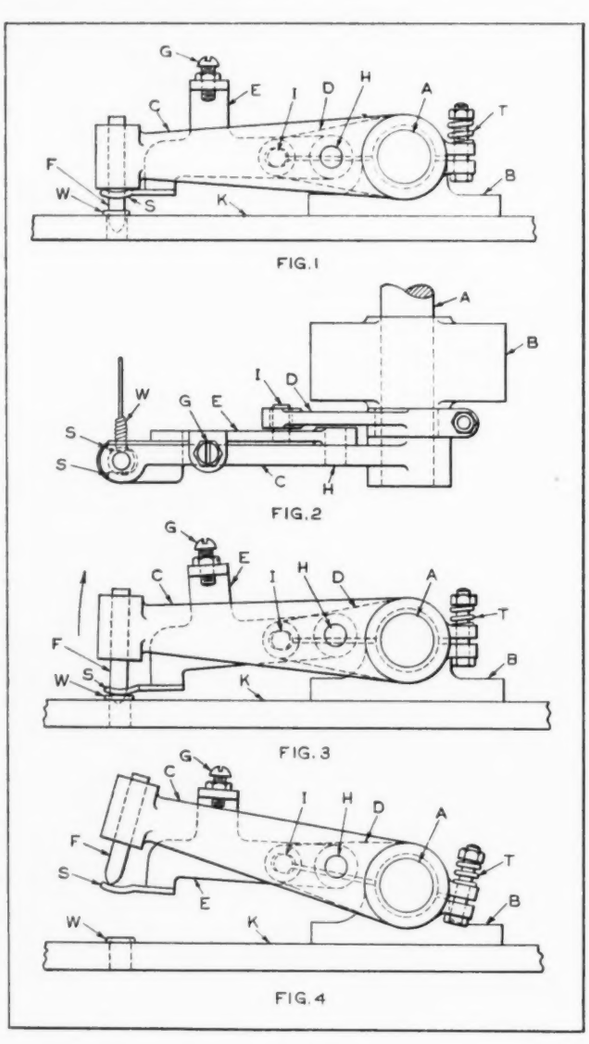


Fig. 1. Stripper Mechanism for Wire-forming Machine with Wire W Twisted around Mandrel F. Figs. 2 and 3. Stripper Fingers about to Strip Wire W from Pin F. Fig. 4. Mechanism with Pin F and Stripper Fingers S Raised to their Highest Points

The assembly is shown in its lower resting position in Fig. 1. Stripping fingers *S* of lever *E* are raised against the under side of lever *C* to allow space for the entrance of the initial forming die, which, at this point, has completed its work and withdrawn. As lever *C* is raised to withdraw pin *F*, lever *D*, being frictionally attached to bearing *B*, is not raised immediately; but, as pin *H* rises with lever *C*, lever *E* is caused to swivel on fulcrum pin *I*.

As lever *C* swings upward, the outer end of lever *E* is caused to swing downward, as shown in Fig. 3. Since fingers *S* at the outer end of lever *E* press the work downward against die-plate *K*, the movement of lever *E* is restricted, and continued movement of lever *C* in the direction indicated by the arrow causes lever *D* to slip on the hub of bearing *B*. The frictional resistance of lever *D* on the hub of bearing *B* thus reacts as a downward pressure on the outer end of lever *E*, as indicated in Fig. 3, and in the plan view Fig. 2.

As the movement of lever *C* continues, its position relative to lever *E* continues to change until screw *G* on lever *E* comes in contact with the upper edge of lever *C*. From this point, the entire assembly continues its movement as a unit, as shown in Fig. 4, until lever *C* reaches its extreme upper position, where it will permit the entrance of a forming die. As the motion of lever *C* is reversed, the frictional resistance of lever *D* on the hub of bearing *B* reacts on lever *E* in the reverse direction, so that the outer end of lever *E* is immediately raised until it comes in contact with the under side of lever *C*, when the entire assembly moves as a single unit until it reaches the position illustrated in Fig. 1, ready for the next stripping operation to be performed.

K. L.

* * *

Munitions Manufacture Speeded up by Using Machine Tools to Capacity

At a recent meeting of the American Society of Mechanical Engineers held in Cleveland, Ohio, for the purpose of discussing the stepping up of war material production, it was pointed out that a great increase in production could be obtained by using existing machine tool equipment to its fullest capacity. One speaker expressed the opinion that 50 per cent of the machine tools installed throughout the United States are not being operated to capacity. They are capable of greater speeds and feeds and higher production. One of the important factors in stepping up munitions manufacture is to convince both supervisors and workmen in manufacturing plants that machine tools can be operated at speeds and feeds much higher than those ordinarily used.

Oil-Well Equipment Built to Drill 15,000 Feet

By CHARLES O. HERB

IN the preceding article dealing with the building of oil-well equipment for drilling to unusual depths, published in March MACHINERY, page 136, a number of operations on drill collars, grief stems, and gears used for oil-well equipment were illustrated and described. The present article is concerned chiefly with operations in the making of tapered roller thrust bearings. Such bearings, of the type seen on the bench in the foreground of Fig. 14, are made complete in the plant of The National Supply Co., at Torrance, Calif., even to the extent of producing the steel. A high-carbon chrome-molybdenum steel is employed for these parts.

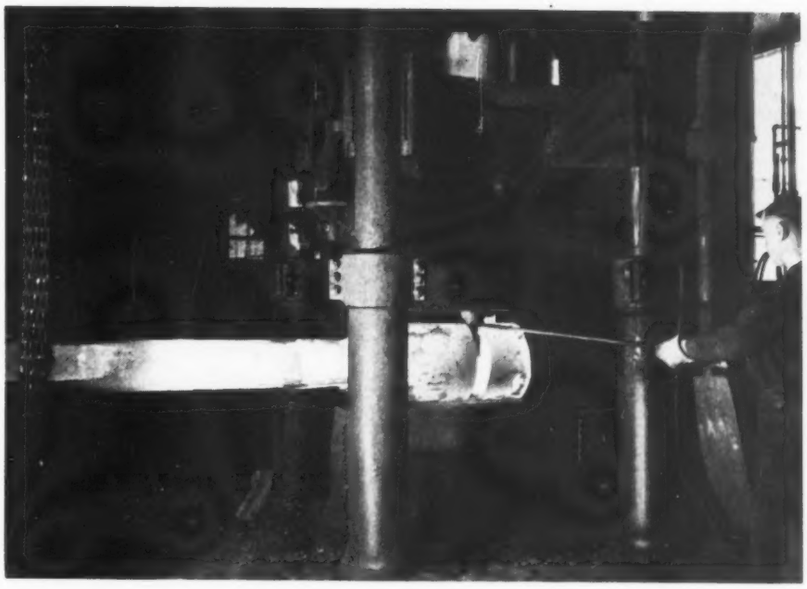


Fig. 10. Cutting off a Section of a Steel Ingot Under the Hydraulic Hammer to Obtain Stock for a Large Tapered Roller Thrust Bearing Race

In Fig. 10 is shown a hydraulic hammer that is used in forging the ingot to the rough diameter and for cutting off a section for a bearing race-plate. The cut-off piece is then flattened to the shape of a thick pancake beneath the hammer, after which it is taken to the oxy-acetylene cutting equipment seen in Fig. 11 for cutting the race-plate to the approximate outside and inside diameters.

After the performance of various machining operations, the race-plates are ground to an angle of 14 1/2 degrees on the roller surface by the Arter surface grinding machine shown in Fig. 12, which also grinds the vertical shoulder around the outer edge of the inclined roller surface. For this opera-

Fig. 11. Employing Templet-controlled Oxy-acetylene Equipment for Cutting a Roller-bearing Race to its Approximate Inside and Outside Diameters

Fig. 12. Grinding the Inclined Roller Surface and Adjacent Shoulder on the Race for a Tapered Roller Thrust Bearing

tion, the grinding wheel is dressed both to a bevel of 14 1/2 degrees and to a vertical plane. As the wheel is fed back and forth across the angular work surface, it is automatically moved up and down to suit, all movements being actuated hydraulically.

The rollers are ground on the tapered surface by the Cincinnati centerless grinding machine shown in Fig. 13. This machine is equipped with a special loading device that feeds each roller between the grinding and feeding wheels to a positive stop. The work is then ejected automatically. Rollers from 1 1/8 to 2 15/16 inches diameter at the large end are ground to an angle of 14 1/2 degrees. Diameter and length dimensions must be maintained within plus or minus 0.0001 inch.

The rollers and races are finally assembled and lapped together on the four stands illustrated in Fig. 14. The assemblies are first placed on the stand at the left, where diamond lapping compound is applied, the top race being revolved on the tapered rollers at 30 revolutions per minute for about a half hour. The roller-race assembly is then transferred to the next stand, where carborundum of about 400 mesh is used in a solution, the top race being rotated at the same speed as in the previous operation for from four to five hours. Each assembly is then transferred to either the third or the fourth stand, where rouge is used in a lapping compound. This final operation requires from eighteen to twenty-four hours, which necessitated the provision of two stands for performing the same operation.

The welding of large work, such as bases and frames for draw-works and other equipment, has been simplified by the use of a manipulator, located over a deep pit, as seen in Fig. 15. This pit is 30 feet in length, and has a maximum depth of 20 feet. The work, when mounted on the revolving table in the center of the manipulator, can be turned to any desired position around both horizontal and vertical planes, so that all welds can be made in level planes. The work seen in the illustration is a sub-base for a steam engine.

For further convenience of the welders, there is an unusual type of ladder which extends both into and above the pit. This ladder can be tilted 30 degrees from the vertical, and it is attached to a base which runs on tracks on the pit platform so that the ladder can be positioned anywhere along the manipulator. A snubbing action holds the ladder in the tilted position. By moving up and down the ladder, the welders can reach any height. Lincoln arc welders are used in performing the welding operation.

* * *

The latest in the way of substitutes introduced abroad is said by the *Compressed Air Magazine* to be telephone bells made from a glass composition instead of metal. It is claimed that these bells meet all the necessary requirements as to sound and durability.

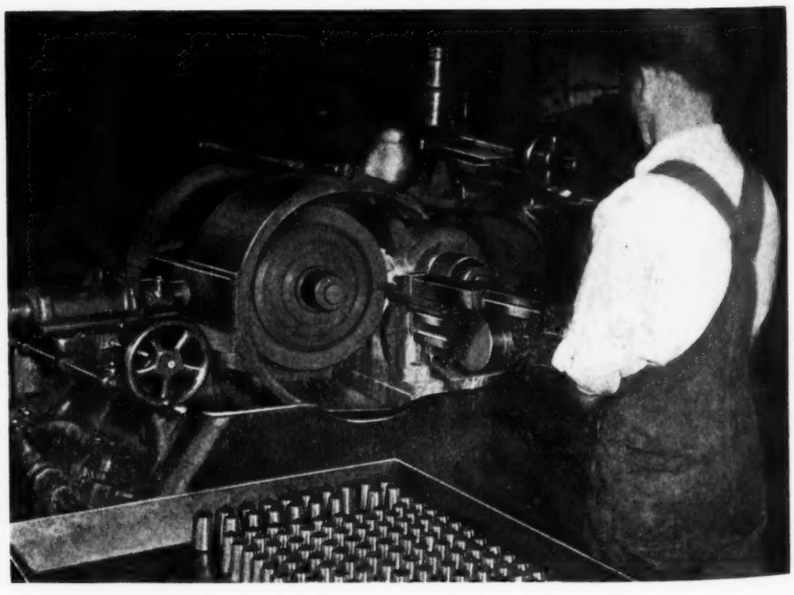
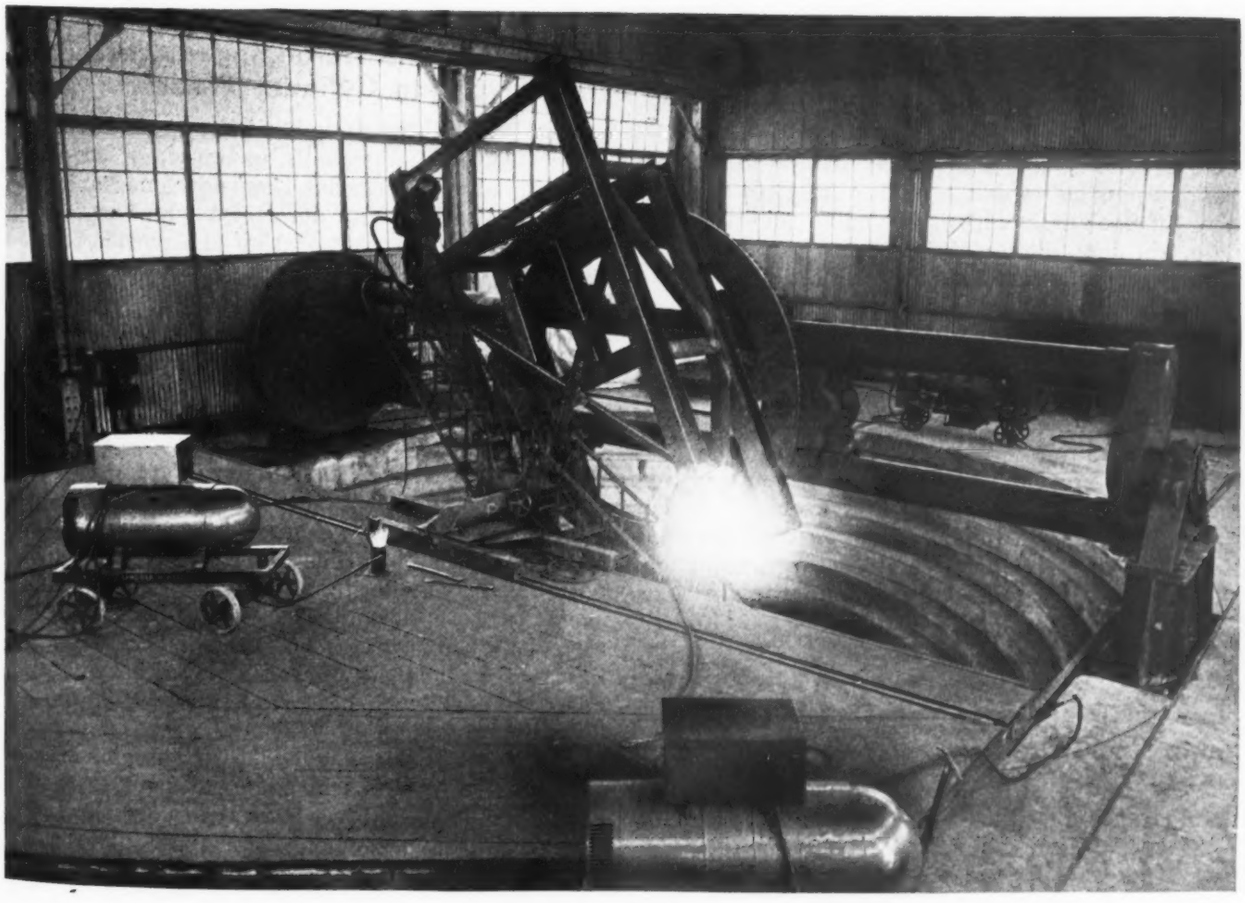


Fig. 13. The Rollers for the Thrust Bearings are Accurately Ground on the Taper by the Use of a Centerless Grinding Machine

Fig. 14. Fine Finish is Obtained on All Working Surfaces of the Tapered Thrust Bearing Rollers by the Performance of Three Lapping Operations

Fig. 15. Welding Operations on Large Work are Facilitated by the Use of a Manipulator, Located Above a Deep Pit, by Means of which Work up to 30 Feet in Length can be Placed in Any Desired Position



Engineering News Flashes

Device for Detecting Natural and Petroleum Gas

A new device developed for the purpose of detecting natural and petroleum gases leaking out through the earth's surface from some hidden deposit of oil or gas was described at a recent meeting of the American Institute of Mining and Metallurgical Engineers held in New York City. It was stated that the device, which has been developed by Sylvain Pirson, assistant professor of the Natural Gas and Petroleum Department of Pennsylvania State College, is so sensitive that it will detect the leakage of 1 cubic foot of petroleum or natural gas per square mile per year. If this device proves as successful as it is claimed to be, it should aid materially in locating vast quantities of oil and gas deposits now unknown.

Underground Conveyor Belts Move Coal at High Speed in Mines

Recently there have been many installations of underground conveyor belts traveling at speeds as high as 450 feet per minute for moving coal in mines. Carel Robinson, consulting engineer of Charleston, W. Va., stated, in a paper read before the American Institute of Mining and Metallurgical Engineers, that such installations have made it possible to double and even triple the volumes of coal delivered at the mine mouths. Besides, the installation of such conveyor belts has eliminated many accidents and reduced delivery delays. The performance of installations in large mines in the West Virginia and Kentucky coal fields has demonstrated that conveyor belt transportation can often be designed in such a manner that the original investment compares favorably with that required for mine car transportation.

One of the most important developments in this connection is a new type of conveyor belt which makes use of the cord-and-rubber construction principle that has enabled tire manufacturers to double and triple the wearing and cushioning qualities of automobile tires.

Unusual Device for Locating Center of Gravity

A device similar to a platform scale has recently been developed by the Soweigh Scale Co., Delavan, Ill., for locating, with great accuracy, the center of gravity of any object placed on the platform. These determinations are made quickly without elaborate calculations. It is planned to offer this device in units up to 100 tons capacity for application in the aircraft, hydraulic, and transportation industries, where balance is an important factor. The location of the center of gravity of huge castings, for example, can be determined with this equipment.

Improved Industrial Lighting for Exacting Work

The "Birdseye Floodlite," made by the Wabash Appliance Corporation, 335 Carroll St., Brooklyn, N. Y., has been designed especially for the purpose of providing a concentrated flood of light in a medium beam that is particularly effective in applications requiring intense illumination for exacting work. Essentially, this illumination unit is an incandescent filament bulb with a lining of pure silver to form a reflecting surface that cannot be dulled or tarnished by dust or fumes. A detachable swivel socket focuses the light on exactly the required spot.

Porous Chrome Hardening—A Process for Preventing Cylinder Wear

A process known as "porous chrome hardening," applicable to cylinder walls, piston-rings, bearings, and similar surfaces, has been developed and patented by Hendrik Van der Horst who has formed the Van der Horst Corporation of America to promote the use of this process. A plant has been built at Olean, N. Y., which is now in operation.

Experiments with this process began in 1932 in Holland, where the first plant using the process is in operation. Later, a plant was built in England, the new plant at Olean being the third erected for the application of this process.

The contention that cylinder wear is caused mainly by corrosion rather than by friction, and the recognition of the great resistance of chromium to corrosion, led Mr. Van der Horst to experiment with the chrome-plating of engine cylinders. Many obstacles were encountered, one of which was the difficulty of obtaining a coating sufficiently porous in texture to hold the lubricating oil. Finally, methods were developed that proved successful, and today the process is in wide and growing use for the cylinders of Diesel, gasoline, and steam engines, compressors, pumps, and pneumatic tools, as well as other surfaces subject to wear or corrosion, such as crankshaft bearings, piston-rods, piston-pins, cross-head guides, etc.

Cutting Threads Close to a Shoulder with Self-Opening Die-Heads

By G. E. MAGER
Eastern Machine Screw Corporation
New Haven, Conn.

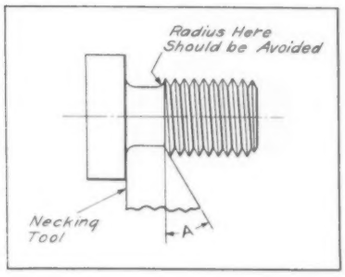


Fig. 1. A Radius where Last Thread Ends, as Shown at Top of Screw, Should be Avoided, and a Bevel Provided by Using a Necking Tool as Illustrated

IN visiting the many factories manufacturing screw machine products, the writer has found that the number of parts in which the design calls for cutting a thread closer to a shoulder than necessary is continually increasing. Specifications often call for a thread that is too close to a shoulder to permit it to be cut on a practical production basis. The writer has frequently obtained the designer's permission to increase the width of the neck. Even a small increase has sometimes been very helpful. In some cases, the tapped hole has been counterbored or a washer placed under the head of the screw; in others, the use of a finer pitch thread has solved the problem.

In the case of a part with no neck, the chamfer of the chasers has often been lengthened to produce a smoother cut; and while this brought the last full thread farther from the shoulder than was originally called for on the drawing, the change has been permitted.

The question as to how close to a shoulder a full thread can be cut with practical equipment depends largely upon the material to be cut, how smooth a thread is required, whether the pitch is coarse or fine, and whether the diameter of the shoulder is small or large. It is well to remember that, when die chasers are purchased, they usually have the chamfer angle ground to a "short throat." This chamfer angle will take in a length of about one and one-half to two threads on pitches of, say, 16

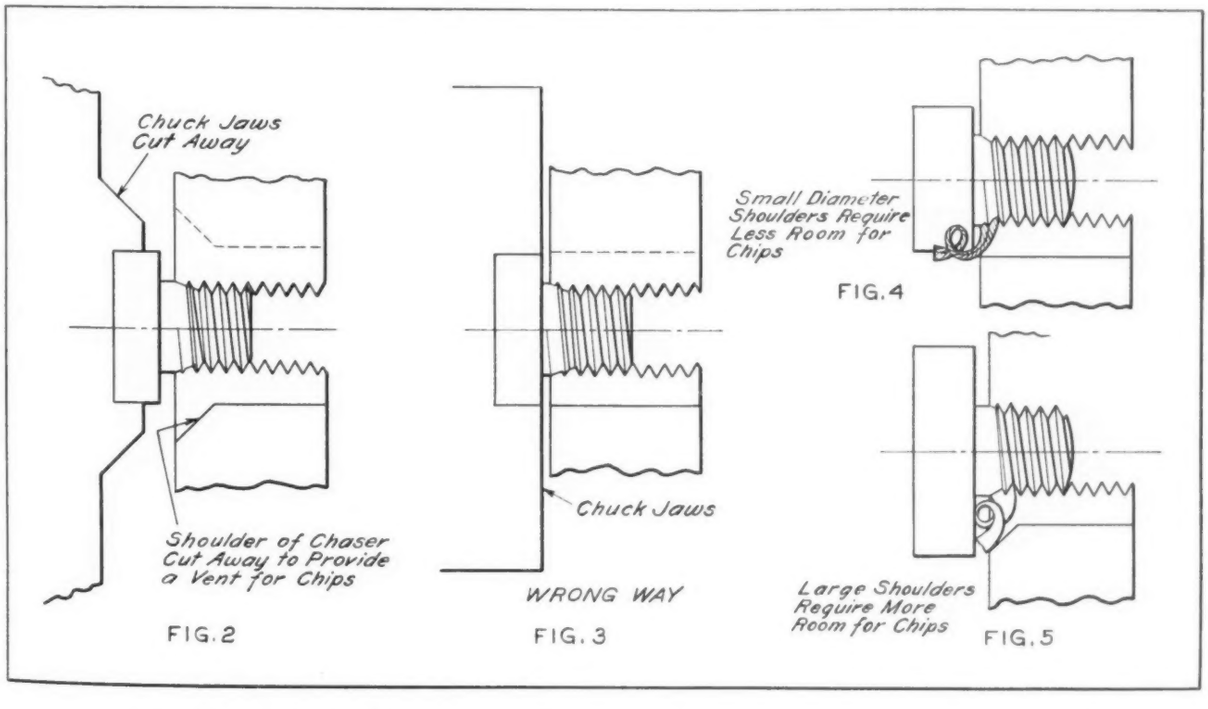


Fig. 2. Chuck Jaws and Chasers Cut Away to Provide Proper Chip Clearance. Fig. 3. Lack of Chip Clearance Such as Shown Here often Results in Damaged Chasers. Fig. 4. Threads can be Cut Closer to Small-diameter Shoulders. Fig. 5. Large Shoulders Require More Room for Chips

and finer. On coarser pitches, up to, say, 8 pitch, the "short throat" chamfer will probably take in as much as two or two and one-half threads. These figures will vary somewhat with the products of different manufacturers, but are close enough to show what are considered the shortest chamfers that will cut well enough on screw stock to test chasers for accuracy in lead, thread form, etc.

Short-chaser chamfers will not usually cut smooth threads on the tough or hard alloys so extensively used today, such as S A E 2330, 3140, etc. Some of the softer materials—such as S A E 1010 and 1020, etc.—also cannot be cut smoothly with short-chamfer chasers.

A threading neck is only as wide as its narrowest measurement; but it is satisfactory, if needed, to put a radius next to the head, provided it is not greater than the length of the chamfer on the chasers. The corner of the necking tool should be slightly broken, but not rounded, where the last thread ends, as this would be equivalent to making the neck narrower (see Fig. 1). A bevel from this point should be formed to reduce the thin fin and burrs that usually curl in toward the neck. Angle *A* is often made 30 degrees, but in aviation work 45 degrees is frequently used to further reduce burrs. This is essential when the screw is harder than the material it goes into, in order to prevent the burrs from damaging the threads in the softer material. Although the threads shown in the accompanying diagrams appear to be of the sharp V-type, they also represent threads of the U. S. form, as this article pertains to the use of self-opening die-heads in cutting threads of both forms.

A die-head cannot be expected to open exactly at the point of "just reaching" a shoulder. Therefore, a little more room than the chaser-chamfer length must be added to allow time for the action of the head to open; and if the pitch of the thread is coarse, the shoulder on the work is large in diameter, or threads are cut close to a chuck, still more room is needed to prevent a jam from a chip getting wedged between the shoulder and chasers or between the chuck jaws and the chasers.

In cases where it is decided that a part cannot be satisfactorily designed without having the thread cut close to a shoulder, and it is agreed that the factory must do the job the best it can, regardless of extra trouble and expense, the following suggestions may prove helpful. Keeping the outside diameter of the work to, or near, the allowable low limit in all threading is usually good practice, and particularly important in close-to-shoulder threading, as it makes it unnecessary to start the chaser chamfer below the outside diameter of the thread, thereby keeping the chamfer as short as possible. It is necessary, in some cases, to use two dies where close-to-shoulder threads are called for and a smooth thread is required. The chasers in the first die are ground with a long chamfer for cutting a smooth thread, while the second die, which follows over the first cut, has chasers of short chamfer to extend the cut of a full thread where the first chasers left off.

In threading close to a chuck, it is best to use extension jaws or holders to provide as much chip room as possible. The outside diameter of the extensions should be as small as is consistent with the strength required to hold the work satisfactorily. The jaws should also be cut away, as shown in Fig. 2. When the chip is long and stringy, the shoulders on the chasers are sometimes ground away to provide clearance for such chips.

Fig. 3 shows a typical troublesome condition. Here the work, which is to be threaded close to a shoulder, is set too far back in the chuck and the chuck jaws are not extended. The danger of the chasers striking the shoulder or chuck jaws, or a chip wedging between them, is ever present. In Fig. 4 is shown a screw with a small head that requires less chip room than the screw with the large head shown in Fig. 5. A head might be considered large when the diameter is greater than standard for that size screw.

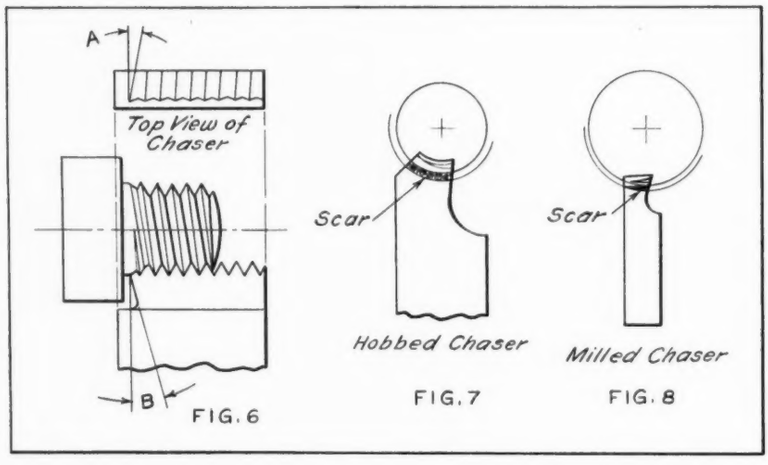


Fig. 6. Chaser Ground to Give Chip Clearance to Help in Threading Close to a Shoulder. Figs. 7 and 8. Diagrams Showing how Chasers are Scarred by Striking Shoulder on Work

A good way to grind chasers required for threading work close to a shoulder is illustrated in Fig. 6, which shows how stock can be removed or cut away from the ends of the chasers to provide more chip room. Angles *A* and *B* can be, say, 5 to 10 degrees. Angle *A* helps to lessen damage to the chaser if it strikes the shoulder slightly. When chasers are seen with teeth that have been chipped off by striking a shoulder, the evidence is usually there in the form of a scar where the chasers hit the shoulder, as indicated in Figs. 7 and 8.

In addition to the usual pull-off trip, an ingenious device consisting of a front-end trip (such as seen at *A* in Fig. 9) is found on most H & G die-heads of the stationary types.

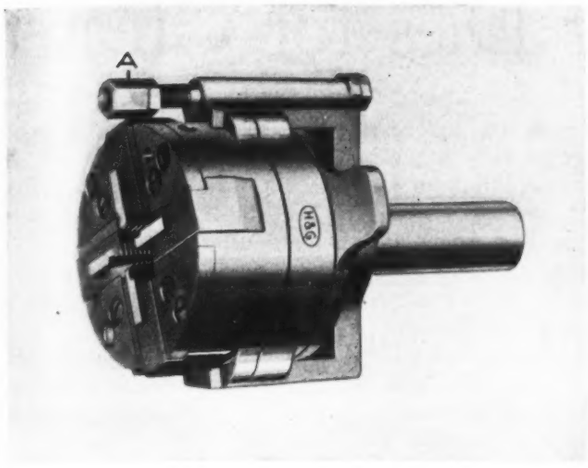


Fig. 9. Die-head Provided with Front-end Trip to Prevent Chasers from Striking Shoulders on Work

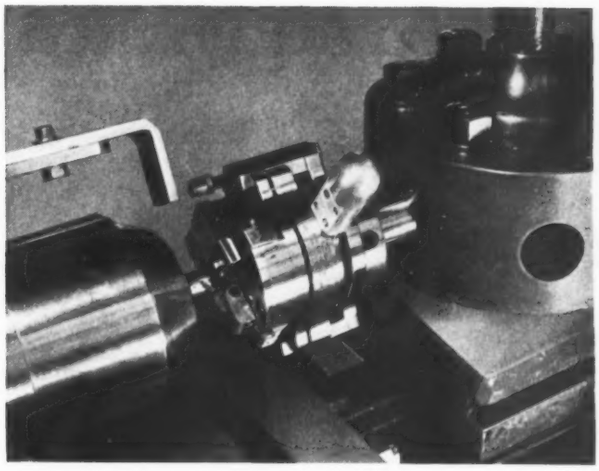


Fig. 10. Die-head with Front-end Trip, Shown in Operating Position, Mounted on the Turret of a Lathe

This trip has done much to prevent chasers from striking a shoulder, and is especially desirable when cutting very short threads. A die-head with a front-end trip is shown attached to a turret lathe in Fig. 10. An adjustable stud is attached to the machine with which the front-end trip makes contact. This trips the die-head. The check-nut on the end of the trip provides for fine adjustment, and can be set to open the head when the chasers are run close to the shoulder, without danger of their striking.

From the foregoing, it is obvious that more room is needed between the last full thread and the shoulder than is generally thought necessary. Lack of attention to this important detail causes production losses, shortens tool life, and results in considerable scrap. The writer feels certain that if a little more thought were given to this subject by designers generally, the shops would be spared much worry and expense. This is especially important now, when no time or effort should be wasted.

Training Program of the General Electric Co.

SHORT-TERM courses in which men are trained in a comparatively few weeks to do one specific job or operate one particular type of machine have been developed by the General Electric Co. to meet the increasing demand for skilled and semi-skilled labor. In the General Electric Co.'s plants throughout the country, hundreds of young men are learning to run lathes, milling machines, drilling machines, and grinding machines, and to perform simple assembly jobs. These short-term courses, however, are only one of the ways in which the company is attempting to meet the labor shortage. It is also conducting specialized courses at all of its plants in cooperation with the vocational schools in the cities in which the plants are located. At the same time, the four-year apprentice training program has been continued in the company's nine major plants.

At the present time, over 1000 young men are being trained in these apprentice courses. All of the apprentices are high school graduates and are over eighteen years of age. In the short-term training courses for specific jobs, the men must be at least twenty-one years old. The majority of these are assigned to machine tool operations, although some are placed on assembly work. The training program for these men may run from three weeks to two months. As soon as a new man takes his place in regular production, another man is engaged for training. As a result of careful selection, the percentage of men who fail to show satisfactory progress is surprisingly small, running from 5 to 8 per cent.

The men are being trained in one of three ways —they may be trained on non-productive work under the supervision of an experienced teacher; they may engage in productive work under the supervision of other highly trained operators; or they may observe and serve as helpers to experienced men.

* * *

The giant hydro-electric power plant at Grand Coulee Dam in the state of Washington recently was placed in operation. Two 10,000-kilowatt station service generators have been started. At a later date, three of the generators now being installed will be put in operation, two in the fall, and one early in 1942. These each have a capacity of 108,000 kilowatts, the largest in the world. Those at Boulder Dam are 82,500 kilowatts each.

Maintenance of Dies for Greater

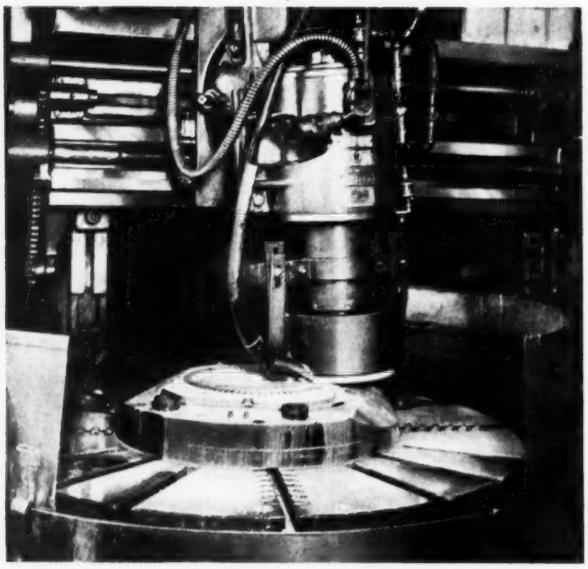


Fig. 1. The Use of a Coolant Directed Exactly at the Point of Cutting during the Regrinding of a Die Prevents Overheating and the Formation of Cracks

SERVICING of dies is an important factor in modern industrial maintenance. This is true not only because dies are usually expensive and it is good economy to prolong their life as much as possible, but also because proper care will insure the production of high-quality work at costs that are ordinarily lower than for other means of production. To secure these results, the grinding and repairing of dies must be as carefully done as the operations required in making new dies.

A number of important factors will contribute to successful die maintenance. These include the use of proper grinding methods, the availability of standard die parts for quick replacement, and the convenient location of the grinding and repair departments with respect to the die department. Best results are secured when (1) a good grade of tool steel is used in new and repair parts; (2) the tool steel is properly hardened; (3) die alignment is maintained by means of leader pins and bushings; (4) a record of die performance, designed to stimulate improvement, is maintained; and (5) a record of maintenance costs is utilized to locate unusual conditions calling for correction.

Tool Steel and Maintenance Costs

From the standpoint of maintenance costs, the selection of tool steel for dies is most important. In this selection, the determining factors are the hardness and resistance to abrasion of the material to be cut, and the production of the die. Thus, for high-production tools, the better grades of tool steel will be the most economical, even though higher priced, for the cost of tool steel is usually a small percentage of the total tool costs.

Care should always be taken to select a tool steel for replacement parts that is of equal quality to that used for the other parts of the die. Continuous breakage or excessive wear of die parts is an indication of the need for an improved tool steel, a change in design, or possibly both.

No die steel will give a better performance than its weakest point, but it is common practice for many repairmen to replace broken parts without serious thought of changing the die design to strengthen weak points and thus improve performance. Although it may not be possible to redesign that part of the die which is broken to obtain all the results desired, a careful study by one who is acquainted with tool steels and die design often results in considerable improvement.

Grinding of Cutting Dies

Best results in grinding will be obtained if the wheel selected is of a type recommended by the manufacturer for use with the particular tool steel from which the die is made. Even with proper grinding equipment, care must be taken to prevent damaging the die surface by grinding with an unclean grinding wheel. Usually a forced flow of water at the point of contact of the grinding wheel and the surface being ground prevents overheating and the formation of grinding cracks on the surface. Die performance can often be improved by grinding a cutting shear to suit the type of die and the material being cut.

Because it is the fine, sharp corners of the die that perform the cutting operation, it is often difficult to determine whether or not the die has been damaged during the grinding operation, and consequently, the subsequent performance of the die is usually watched for indications of such damage. When correct grinding methods are used, however, the discoloring of hardened die surfaces and injury to cutting edges will not develop.

Repair of Dies

Provision for economical maintenance should be made by having available a supply of standard repair parts for the particular style of tools in use. The kind of parts that are to be kept in stock should be determined by persons in charge of repairs, who also should determine the number of pieces to be carried in stock. In replenishing the stock of repair parts, it should be remembered that a numbert of parts can often be made at one time by a small addition to the cost of a single part.

If workmen who are repairing dies are located near the punch press department, the supervision of most repair problems will be greatly simplified.

Production

By H. J. HAWK, Time Study and Methods
Westinghouse Electric & Mfg. Co.

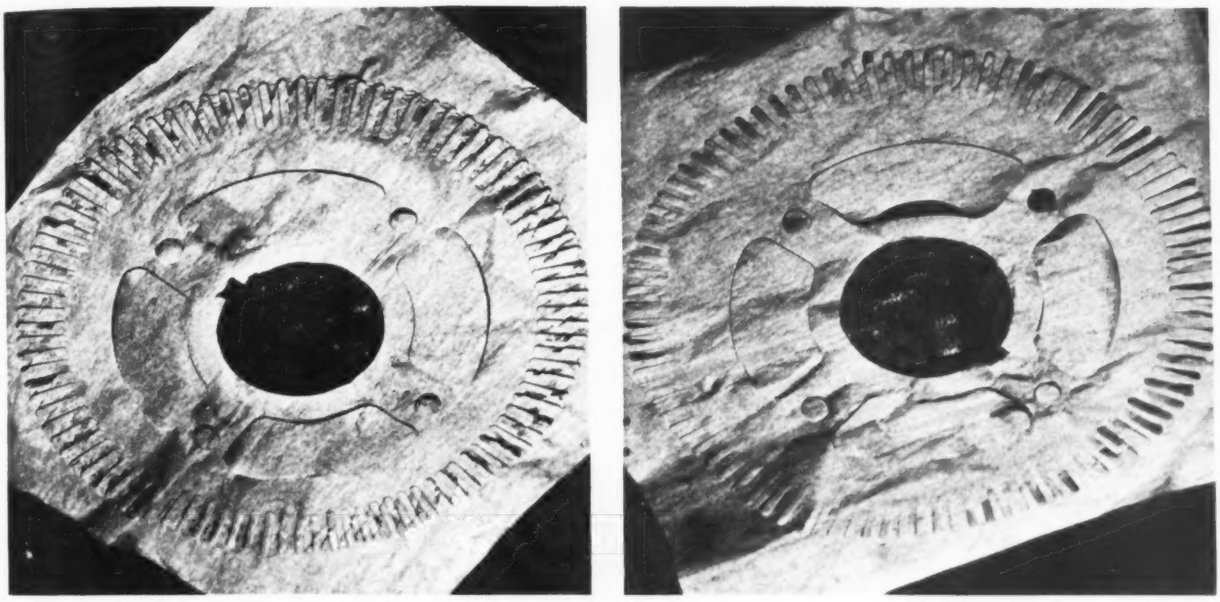


Fig. 2. Checking Die Alignment with Paper of About Same Thickness as Die Clearance. Correct Alignment is Shown at the Left by the Fact that the Paper is Embossed rather than Cut. Incorrect Alignment is Shown at Right by the Fact that the Paper is Cut on One Side

Furthermore, with repairmen readily available for the light repairs and adjustments that can be made with the die in the punch press, delays in production are reduced to a minimum. The nearby location of grinding equipment for the sharpening of dies will also result in economies.

Leader Pins and Bushings Reduce Maintenance Costs

Almost all dies present their individual difficulties, but lamination dies need extra precautions to eliminate excessive maintenance costs. Thus, a die with a break clearance of approximately 0.001 inch per side requires leader pin and bushing fits to be maintained with care. These leader pins and bushings should be of a standard design and assembled in such a way as to facilitate frequent replacement. When these close fitting parts wear to a clearance approximately the same as the break clearance in the die, they should be renewed. The cost of replacing leader pins and bushings is small, compared to the expensive die life endangered by working a die after these pins and bushings have become badly worn. Leader pins and bushings should be provided with a simple method of applying lubrication, so that the operator will not neglect this essential operation.

Die alignment is an important factor in maintenance, but is often neglected by tool repairmen. Tools with small break clearances that are used for cutting thin material, such as thin laminations, need more attention as regards alignment than those that are used to cut some of the heavier materials. These break clearances, even though small, must be maintained for successful performance and the prevention of damage to the die.

Some toolmakers and die-setters consider a die with small break clearances to be satisfactory if the punch enters the die without great difficulty. There are, however, several methods commonly used for checking close fitting dies, as, for example, the cutting of a paper blank and the examination of the first few blanks cut. These methods should not be considered an accurate indication of good die alignment. A better way is to test the action of the die by using a material of approximately the same thickness as the break clearance in the die, preferably a tough paper. After the grinding burrs have been removed from the die, proper alignment will be indicated by the fact that the paper is embossed rather than cut. If the die is out of alignment, it will be found that the paper is cut on one side.

Records Reduce Maintenance Cost

Most dies need some attention by grinding and renewing, and it is good practice to keep a record of their production between such maintenance operations. This is of particular value in the case of high-production tools. Such records tend to stimulate an interest in improving the performance of the dies. Often they lead to a change in construc-

DIE ACTIVITY AND MAINTENANCE RECORD

TOOL NO. 14263

	1	2	3	4	5	6	7	8	9	10
NUMBER OF CUTS	10164	110122	125050	40000	35000	116000	80000	114025	25000	133578
CHECK FOR WORK BELOW	Date 4/2/40	Date 4/6/40	Date 4/10/40	Date 4/22/40	Date 4/28/40	Date 5/4/40	Date 5/7/40	Date 5/14/40	Date 5/18/40	Date 5/22/40
RE-GRIND	✓	✓	✓	✓	✓	✓	✓	✓		✓
AMOUNT GROUND OFF DIE	.010	.008	.015	.005	.020	.008	.005	.020		.010
AMOUNT GROUND OFF PUNCH	.012	.015	.010	.015	.032	.015	.015	.040		.012
ALIGN PUNCH AND DIE			✓				✓			
BROKEN PUNCH								✓		
GUIDE PINS AND BUSHING							WORN	RENEWED		
HEIGHT OF DIE / HEIGHT OF PUNCH	3/4 / 1/2									5/8 / 3/4
GENERAL REPAIR										
Punch Clipped					✓					
Order Completed									✓	
Die Clipped								✓		
COST—MAN HOURS	4 1/2	3/4	3/4	2 1/2	2 1/2	3/4	3/4	14	4 1/2	3/4

Fig. 3. Card Used for Recording Production and Maintenance of Dies. Such a Record May Lead to Improvement in Die Design

tion or design, and improvement in one die may suggest changes in other dies that will raise their production life to a comparable level.

A record of the cost of repairs, particularly on high-production dies, helps the die supervisor by eliminating guesswork in determining the need for a change in design or methods. Such records tend to obviate the common practice of continuing to repair a die by the same method or type of construction as was used originally.

* * *

Annual Reports that Present the Facts Simply

Several large corporations have recently issued annual reports to their stockholders and employes in a form that differs materially from that generally employed by accountants, but presenting a much clearer picture to the average man. One of these reports for 1940 has been issued by the Farrel-Birmingham Co., Inc., Ansonia, Conn. This report shows, both by simple figures and by graphical illustrations, how much of each dollar received for machinery and parts sold to customers is being used for different purposes.

For example, for every dollar received, approximately 35 cents is paid for raw materials, supplies, fuel, power, and transportation; 37 cents is paid in wages to factory employes, and 6.5 cents in wages and salaries to engineering and office employes; while the share of the executive officers of the company, in salaries, amounts to 1.2 cents. Taxes of all kinds took approximately 9 cents. Miscellaneous expenses amounted to about 2 per cent.

After all expenses had been paid, there was left as a reserve against future contingencies (that is, "savings for a rainy day") and for payment to stockholders for the use of their money during the year slightly less than 9 cents. In fact, taxes absorbed a little more than all that was left for a reserve and for payment to those who provided the buildings, machinery, and other equipment that made it possible to employ people.

It is also worthy of note that, during the entire ten-year period of 1931 to 1940, the company paid out $47 in wages and salaries, exclusive of the salaries of executive officers, for each $1 of net earnings. Also, in 1940, taxes were 72 per cent greater per dollar received for the company's products than the average for the ten-year period; and if we go back and make a comparison between seven years ago and today, we find that taxes are nearly three times as great for each dollar received.

* * *

Exports of Metal-Working Machinery and Machine Tools

A sharp decrease in the exports of power-driven metal-working machinery is indicated by the statistics of the Machinery Division, Department of Commerce, Washington, D. C., for the month of February. The shipments for that month were 32 per cent below the January level, owing chiefly to reduced exports to Great Britain. However, the February exports of all industrial machinery from the United States totaled close to $37,500,000, only 13 per cent below the January value of nearly $43,000,000.

The machine tool exports to England dropped from $17,000,000 in January to $8,700,000 in February, and England's share in the total United States machine tool exports declined from 77 to 58 per cent. The shipments to Canada continued to increase, however, totaling $4,275,000 in February, as against $3,800,000 in January. Exports to Japan declined to slightly less than $17,000, as compared with $217,000 in January. The exports to Russia rose from $95,000 in January to $485,000 in February. The total exports of power-driven metal-working machinery in February amounted to $16,550,000, as compared with $24,400,000 in January, and $28,750,000 in December, when an all-time record was reached. Exports of metal-working machinery other than power-driven rose from $1,039,620 in January to $1,374,332 in February.

Die for Forming Wire Clip

By L. KASPER, Philadelphia, Pa.

The accompanying illustration shows a die for forming clip *W* from round Monel metal wire. The die is so constructed that it automatically ejects the finished piece.

In Fig. 1 the die is shown with the punch at about the middle position of the working stroke. Die-block *A* carries two plates *D*, the upper inner edges of which form the wire around forming punch *L* and also act as retainers for the internal mechanism. Block *A* is recessed to receive forming block *B*, which is resisted in its downward movement by springs *H*. Block *B* is grooved on both ends to accommodate the forming levers *C* which swing freely on their pins.

The spring *I* in block *B* acts against two sliding pins, forcing levers *C* outward against the internal surfaces of block *A*. Block *A* carries block *F*, the upper edge of which serves as one of the cutting edges for cutting off the material, the outer edge of plate *D* forming the other cutting edge. Block *E* is grooved to guide the wire across the face of the die against stop-plate *O*. Block *B* is held within block *A* by retaining plates *G*, shown only in Fig. 3.

Punch-holder *J* carries cut-off punch *K* and forming punch *L*. Punch *L* is so designed that its shank will not enter die-block *A* and interfere with the

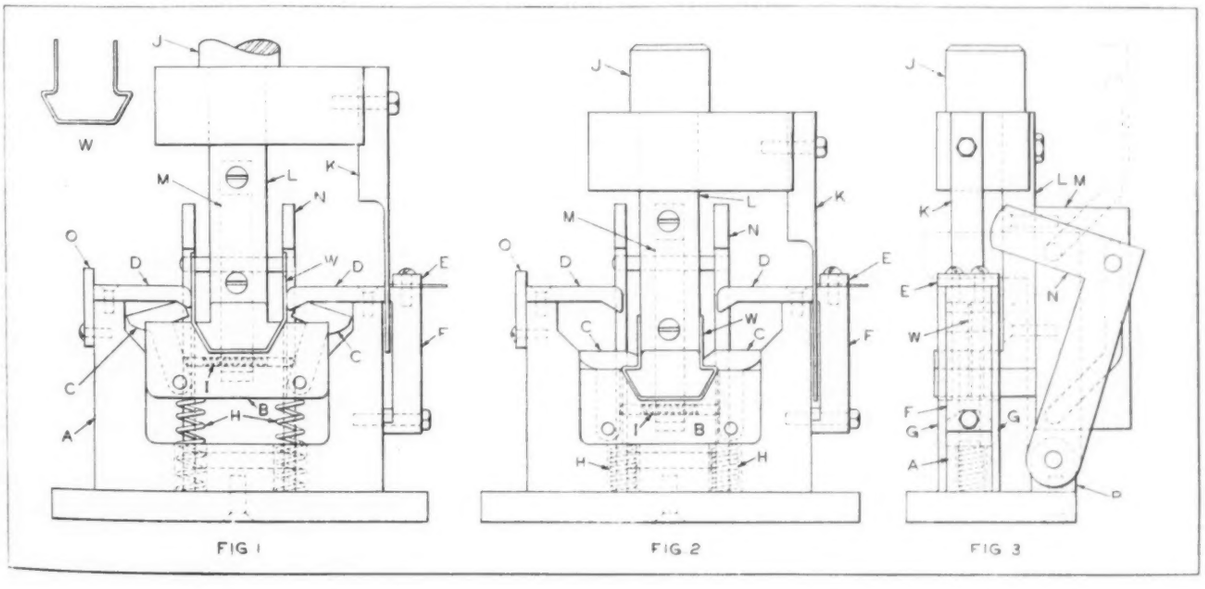


Fig. 1. Front View of Die for Forming Wire Clip W, with Punch L Shown Near the Middle of its Down Stroke. Fig. 2. Die Shown in Fig. 1 with Work W Formed and Punch L at End of Down Stroke. Fig. 3. End View of Punch Shown in Fig. 2

wire as it is bent around the forming end. Punch *L* carries at its back a cam-plate *M* which operates ejector *N*, the latter swinging freely on a pin in block *P*, Fig. 3.

In operation, the wire is passed through guide block *E* across the face of the die and against stop *O*. As the ram of the press descends, punch *K* first severs the wire to the correct length and punch *L* then forces the wire between the inner edges of plates *D*, forming it into a U-shape. Continued movement of the ram forces the roughly formed wire into the angular shaped groove in block *B*, the shape of the wire at this point being as shown in Fig. 1. Springs *H* are sufficiently powerful to support block *B* in its upper position, no movement of the block taking place until the wire is shaped to the angular groove.

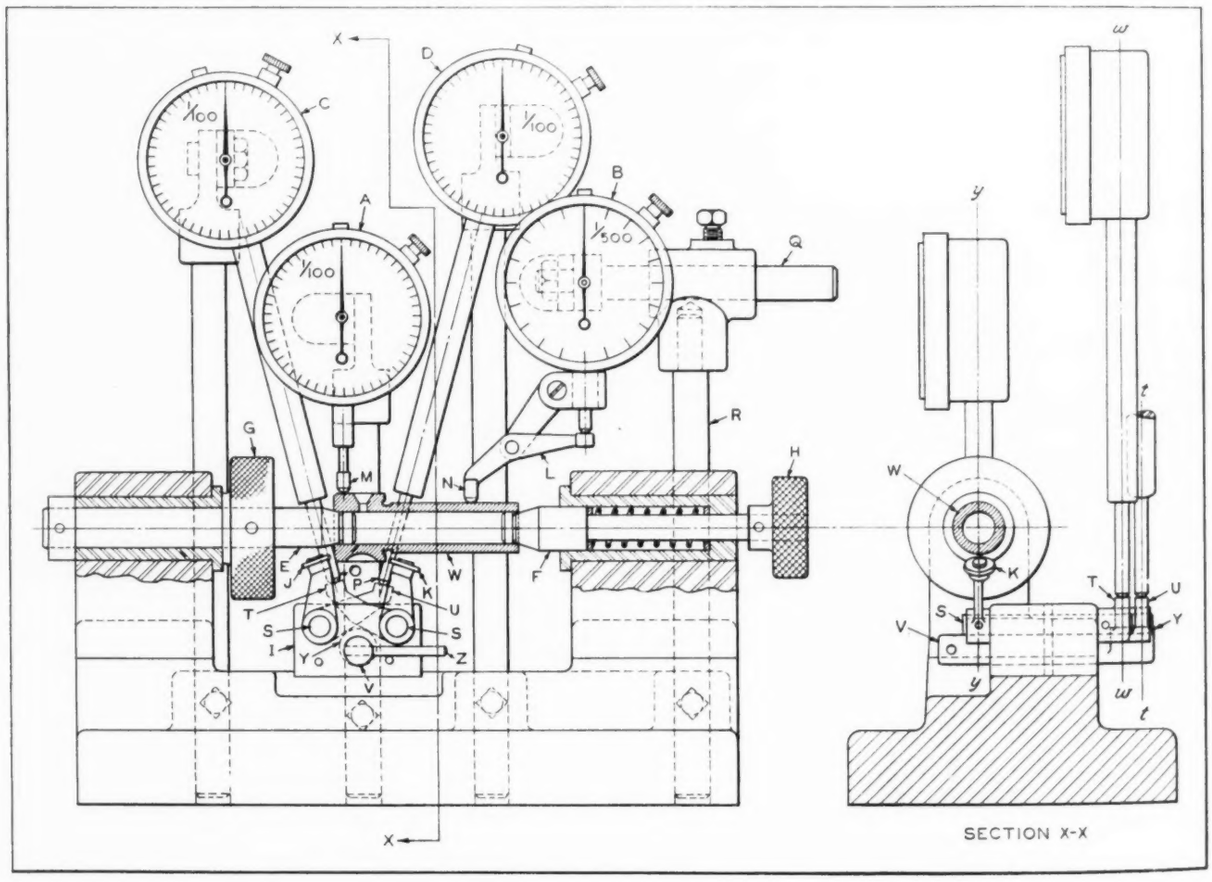
As the ram descends further, block *B*, carrying levers *C*, is depressed into block *A*. When the back ends of levers *C* come in contact with the angular internal surfaces of block *A*, they are forced inward until, as block *B* strikes the bottom of the groove in block *A*, work *W* is completely formed, as shown in Fig. 2.

In this position, the ejector is located as shown in Fig. 3, which is an end view of Fig. 2. As the ram ascends, work *W* is lifted out of the die by punch *L*. Owing to the fact that the upper part of the slot in cam-plate *M* is straight and parallel with the line of travel of the ram, there is no movement of ejector *N* until its pin, which passes through the slot in cam-plate *M*, reaches the angular portion of the groove. At this point, the work has been lifted entirely clear of the die, and continued upward movement of the ram causes the angular portion of the slot in plate *M* to swing the ejector forward. At the extreme upper position of the ram, cam-plate *M* and ejector *N* occupy the positions shown by the dotted lines in Fig. 3, at which point work *W* has been forced off the end of punch *L* and thrown clear of the die.

Multiple-Function Dial Gaging Fixture

By FRANK HARTLEY

An important feature of dial gages is their adaptability to multiple arrangement for checking several dimensions simultaneously or at one setting. The accompanying illustration shows an arrangement of this kind in which four gages are grouped about work *W*. Gages *A* and *B* serve to check the concentricity of the two diameters, while gages *C* and *D* are employed for checking the



Fixture Equipped with Four Dial Gages for Testing Piece W for Concentricity on Two Diameters and Squareness of Head and Shoulder of Enlarged End

squareness of the shoulder and the end of the work. The work W is an engine valve-seat, and all the surfaces tested are ground.

The piece is held in position for gaging by spindles E and F which enter the hole in the work for a short distance, each spindle having a straight portion at its end and an adjacent section which is slightly tapered, so that the work will be accurately centered on the spindles, regardless of the slight manufacturing variation allowed in the hole diameter.

Spindle E is mounted in a bushing in which it is free to turn, and is located endwise by a knurled ring G through which the work can be revolved. A collar is pinned to spindle E at its opposite end to secure the assembly. Spindles E and F are mounted in similar bearings, and spindle F is retained in its bushing under tension of a spring which tends to push it into the work and hold the work endwise under spring tension. The knurled knob H is used to pull the spindle back while putting the work in place. The base of the gage supports four dial-indicator posts and a block I for the squareness-testing fingers on which the work-contacting rollers J and K are mounted.

The simplest indicator mounting shown is used for dial A, the gaging point M of this dial being in direct contact with the large diameter of work W. Indicator B gages the concentricity of the small diameter, and here the indicator contact point comes against a small lever L having a gaging point N that is directly in contact with the work. Lever L is supported on the indicator stem by a small arm carrying a stud on which the lever pivots. With the points M and N in contact with the two diameters of the work, the inspector revolves the work by turning collar G with the finger of his left hand while taking readings of dials A and B to see if the indicating needle swings within the limits of concentricity allowed.

For convenience in putting the work in place, indicator B, with its holding stem Q, is mounted in a swivel block which can be swung about the post R, so that gaging point N is clear of the work. The two concentricity indicators A and B are mounted in the plane y–y indicated by the end view, while the two squareness indicators are mounted in the planes w–w and t–t. No attempt has been made to show in detail the construction of the indicator mountings, the object being merely to illustrate the principle involved.

Referring to the squareness indicators C and D, an auxiliary mounting is provided in block I for two shafts S which carry the short arms on which rolls J and K are mounted. The rolls are free to pivot on studs on the arms. These rolls come in contact with the shoulder and end of the work, any irregularities in these surfaces being transmitted through shafts S to levers T and U pinned to their respective shafts. The contact point P of indicator D rests against the flatted end of lever U, while the contact point O of indicator C rests against the flat on lever T. There is a spring (not shown) attached to the two arms T and U, which serves to pull these arms toward each other so that rolls J and K will make contact with the work. If the end of the work is out of square, movement will be transmitted by the arm with the contact roll J through lever U to dial indicator D, where a reading is taken to see if the variation is within the allowable limits for squareness. In like manner, irregularities in the shoulder are transmitted by the arm carrying roll K through lever T to contact point O and indicator C.

The stud V, with its eccentric Y, is turned by hand in block I by means of pin Z through an arc determined by two limiting pins. Its function is to bring the eccentric end in contact with the two levers T and U, thus holding them up and opening the gap between the two rolls J and K for convenience while putting the work in place.

While this gage may at first appear to be rather complicated, its use is very simple. With rolls J and K held out of contact with the work in the positions shown, the inspector, by grasping knob H and withdrawing spindle F, can easily remove the work or put a new piece in place. The contact point M is simply lifted up by the work while it is being put in place. Contact point N is swung over the work by pivoting gage B and its supporting rod Q on post R. Flipping or turning pin Z in a counterclockwise direction allows rolls J and K to come in contact with the work, after which the operator revolves knob G, thus turning the work for taking the various dial readings for concentricity and squareness.

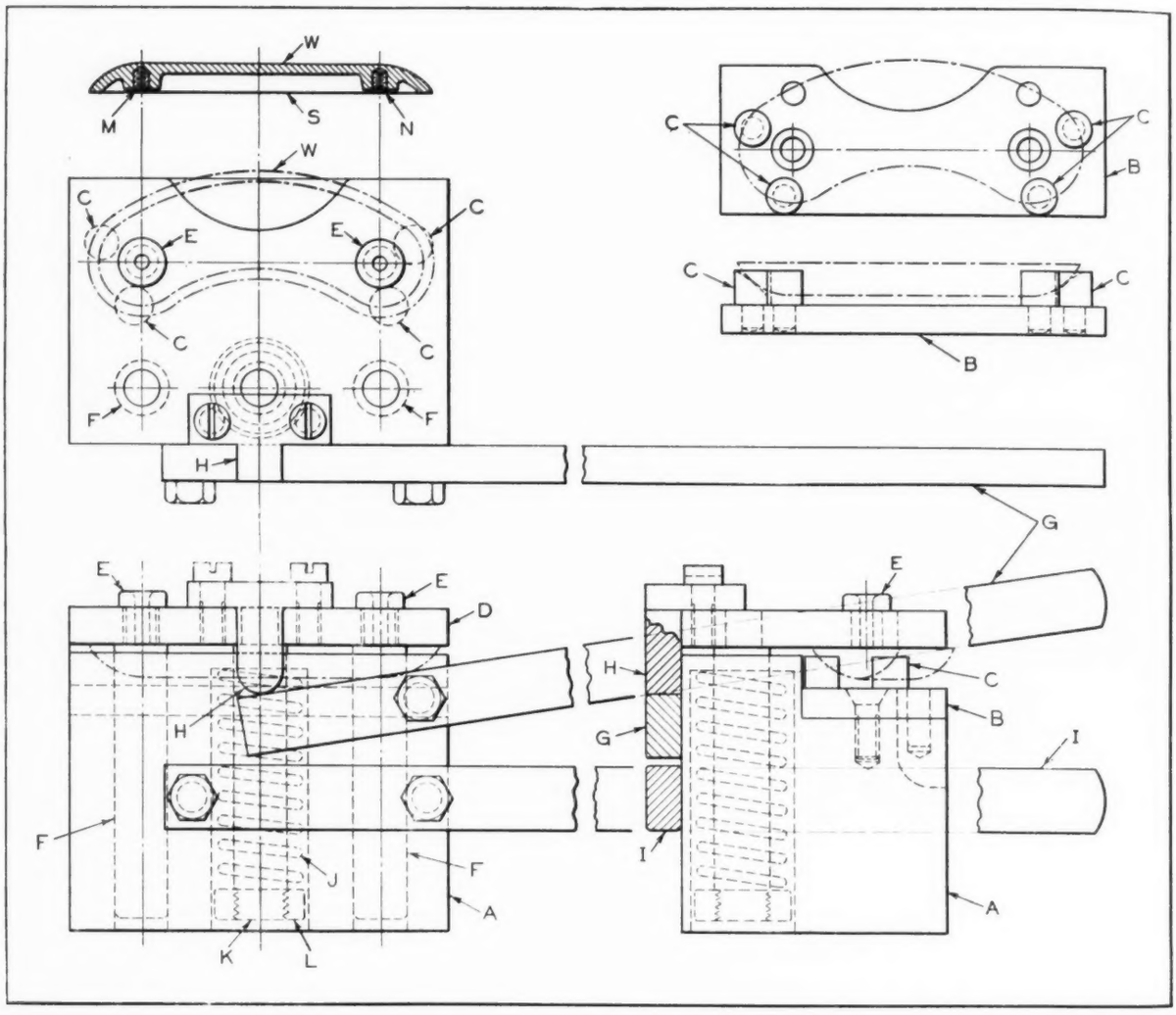
Jig for Drilling Small Part of Irregular Shape

By GEORGE WILSON, Mankato, Minn.

The drill jig shown on page 138 was designed to hold a cast-iron piece W of irregular shape which presented a rather troublesome clamping problem. The job is to drill and tap the bosses at M and N, keeping the tapped holes as nearly as possible in a central position with respect to the circular ends of the bosses.

The flat surface S of the work is first smoothed off on a disk grinder. Drill jig body A is provided with a locating plate B which is held in place by screws and dowels. The four beveled pins C, set in plate B, center the work by contact with its circular or rounded ends. A top view of the locating plate B and beveled pins C is shown in the upper right-hand corner of the illustration.

Bushing plate D, in which the drill bushings E are mounted, is provided with guide pins F which move vertically in body A. Pivoted lever G engages lug H attached to plate D. Lever G, together with fixed member I, also serves as a handle for moving and holding the jig on the drill press.



Quick-clamping Jig Used in Drilling and Tapping Holes in Casting W

Bushing plate *D* is held down against the work by means of a stiff spring *J* located in a counterbored hole in body *A*. Lever *G* is pressed down to raise plate *D*, so as to permit the work *W* to be placed in position on locating pins *C*. Stud *K*, pressed into plate *D*, together with nut *L*, serves to take the thrust of spring *J*. In using the jig for tapping, the drill bushings are removed. The method of using a spring- or lever-operated bushing and pressure plate, as shown in the illustration, has been found very useful in handling a variety of light drilling and tapping work.

* * *

Drill pipe of 2 per cent nickel and 1 per cent copper high-tensile steel which was installed over two years ago in the West Coast oil fields, has served so well that a great increase in its use for this purpose is predicted. The same steel is also increasing in use for sucker rods, an application for which its combination of strength and resistance to corrosion-fatigue makes it well suited.

Government of Unoccupied France Regulates Machine Tool Industry

The government of unoccupied France has created for the machine tool, small tool, and welding industries an organization committee vested with considerable powers. The committee comprises six members, one of whom is its responsible president. The functions of each member of the committee are clearly designated. In addition, there are five subcommittees, each covering the following fields: (1) The manufacture of machine tools and woodworking machinery; (2) the manufacture of presses and metal-forming machinery; (3) the manufacture of cutting tools, grinding wheels, and portable pneumatic and electric tools; (4) the manufacture of welding machines and accessories; and (5) commercial matters, such as the importation and resale of machine tools, woodworking machinery equipment, and accessories. Dues will be levied on the firms in the industry to cover the cost of the committee's work. This is another evidence of the worldwide tendency toward government control.

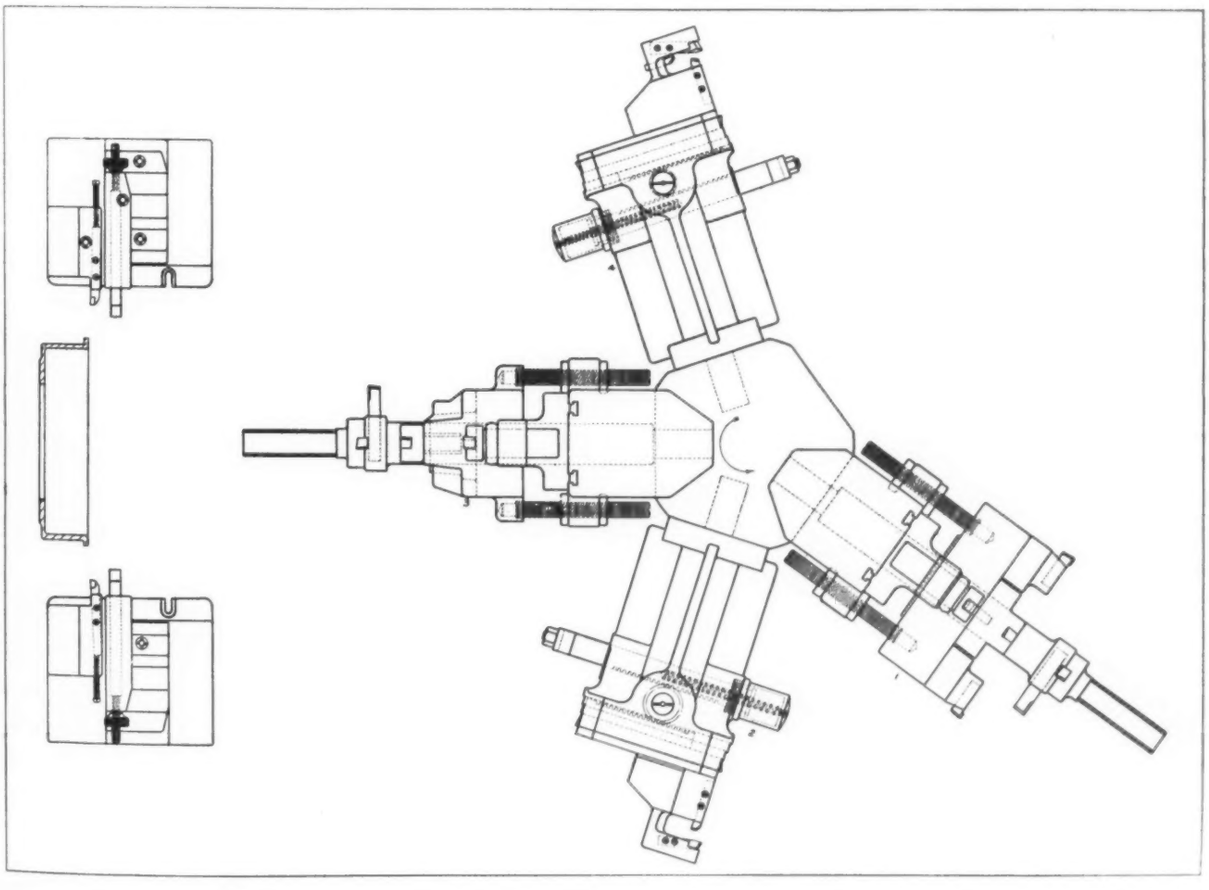
Unusual Tooling Arrangement for Machining Brake-Drums

FLEXIBILITY and rapid production are advantages obtained with the tooling arrangement provided on a Potter & Johnston automatic for machining brake-drums used in military and commercial vehicles. A photograph of this machine as set up for this work and a description of its operation were presented in the article "Gun Bogies, Limbers, and Truck Axles from the Timken-Detroit Plant," which appeared in April MACHINERY.

The need for flexibility in the tooling arrangement arose because brake-drums of several different sizes and types were to be handled by this machine, and it was important to keep the change-over time to a minimum. The accompanying illustration shows a plan view of the tooling arrangement. To provide for changes in the outside diameter of the various brake-drums handled by this machine, the outside-diameter turning tools for roughing at turret station No. 1 and the outside-diameter turning tools for finishing at turret station No. 3 were rigidly mounted in brackets which can be quickly adjusted up or down by releasing four clamping bolts and turning a ball-crank handle.

Another part of the tooling problem which was satisfactorily solved in a rather unusual fashion was the adjustment of the three boring cutters on the first turret face. A scroll chuck was mounted on the boring-bar, and to each of the chuck jaw slides was attached a tool-block. With this arrangement, it was found possible to quickly set out the three boring cutters for a variation of 1 inch in the diameters of the brake-drum bores. In actual use, it was rarely found necessary to vary the adjustment of the backing screws in contact with each individual cutter, since the head in question was used for rough-boring. Thus, this form of universal adjustment proved to be entirely satisfactory.

To accomplish the rough and finish straddle-facing of both sides of the web, two reverse-action slide tools were attached to the turret faces at stations Nos. 2 and 4. These are operated by the action of the cross-slide while the turret-slide dwells at the extreme forward end of its stroke.



Tooling Arrangement Used on Potter & Johnston Automatic for Machining Brake-drums

EDITORIAL COMMENT

Early in April, tens of thousands of men engaged in the production of equipment urgently needed for the defense of all that the United States stands for, were idle, chiefly because some labor leaders were using the national emergency to fortify their own position and that of the unions which they control. It appears that to these labor leaders their own aggrandizement is far more important than the welfare of the nation. We believe, however, that the majority of the striking workers are not in sympathy with the actions of their leaders, because the American industrial worker is no less patriotic than any other group of citizens; but through the strategy of the labor leaders, he becomes a helpless tool in furthering their ambitions and purposes.

Are Labor Organizers Using Nation's Danger to Further Own Ends?

However, serious as is the attitude of certain labor leaders in holding up the manufacture of defense equipment, it is not so serious as the complacent attitude of the Administration and of Congress. Until early in April, nothing had been done by these two branches of our Government to remedy the situation. In fact, the President himself and the Secretary of Labor had minimized the seriousness of the strike situation by pointing out that the number of man-hours lost was small, in comparison with the total number of man-hours expended on the defense program. In the last few weeks, there has been much talk and some action, but on the whole, the settlements have been one-sided. The labor leaders have not hesitated to exploit the national emergency, and have achieved their ends without regard to the national interest.

President and Congress Have Lacked Backbone in Munitions Strikes

The average citizen has good reason to believe, from the evidence at his disposal, that men in high office are playing politics. He feels that the Administration and Congress have lacked backbone in dealing with these strikes, and that unscrupulous labor leaders have had the upper hand.

Is one kind of loyalty expected from industrial leaders and another from union organizers? We have enacted into law provisions (that it has never been found necessary to apply) giving to the President power to take over a manufacturing establishment if, in his opinion, its owners are obstructing the manufacture of defense equipment. But Congress has given no power to the President to deal in equally effective fashion with labor leaders who conspire to stop the manufacture of munitions; nor has the President up to the present writing asked for any such power. In fact, his utterances early in April indicated that even if he had such powers he would not make use of them. The present situation is the inevitable result of the policies followed by the Administration. So much for the Government's attitude.

There is no evidence that the strikes in our defense material plants have been fomented by Nazi influence; but if the labor leaders who have been responsible for organizing and calling these strikes had actually been Nazi agents, they could have served Herr Hitler's purposes no better than they have done. What cheerful news it must have been to Mr. Hitler and his fellow organizers of the New Order to learn each morning of the strikes, riots, and violence organized and fomented by labor leaders in the defense industries of the United States.

He Who Obstructs the Manufacture of Arms Aids the Enemy

We are at war. Let there be no mistake about that. At this writing, there has been no declaration of war; but the issue is drawn, although there are still a great many people in the United States who do not recognize the seriousness of the world conditions or the threat that is leveled at the very foundation of our form of Government and our way of life. None the less, we are now engaged in fighting the Powers that would, if they could, destroy our Government and our liberties. We are at war with these destructive forces, and are straining our industrial and economic resources to the end that we may not be subdued by them. For that reason, everyone who obstructs the manufacture of war materials, whatever the pretext may be, is giving direct aid to the enemy.

The obvious right of labor to seek equitable adjustments is one thing; playing labor politics at the expense of national defense is quite another thing. Between that and the deliberate sabotage of defense operations there is, in effect, no practical difference. It is high time that the President and Congress stop blinking at the facts.

Shell-Machining Chart

Chart for Coordinating Speed, Feed, Depth of Cut, Horsepower, and Tool Life of High-Speed Steel and Sintered-Carbide Tools for Maximum Production of Artillery Shells—Abstract of Paper Presented before Third Army-Navy Meeting of American Society of Mechanical Engineers on National Defense, at Cleveland, March 12

By Dr. M. KRONENBERG, Research Department
The Cincinnati Milling Machine Co., Cincinnati, Ohio

IN order to speed up the production of war materials, it is of importance that the results of metal-cutting research be made readily available to those concerned with machining operations. It is preferable to use these results whenever possible rather than to continue to be guided by the customary "rule-of-thumb." The slow method of trial and error ought to be eliminated.

Shops engaged in defense work need methods that will enable them to utilize quickly the results of research in metal cutting. In general, however, the data collected are not available for ready use. The present article, therefore, presents charts that are making the results of metal-cutting research easily applicable to the problem of machining shells. Obviously, similar charts can be prepared for different materials and machining operations. These charts are based on the best data available. They have been checked with the results of investigations made both in this country and abroad. They have also been found to conform to practical results obtained in shell turning.

The most recent data on metal cutting are presented in the "Manual on Cutting of Metals," published by the American Society of Mechanical Engineers in 1939. The data in this manual, however, cannot be readily used directly, due to the complexity of the correction factors to be taken into consideration. Lengthy calculations would have to be made for each specific case of speed, feed, etc. This is in no sense a reflection on the Manual, as the abundant data contained in this work are extremely useful.

Complex formulas are not suitable for shop use, especially when the information is required quickly. Tabulations, on the other hand, cannot possibly show the relationships of a great multitude of variables; therefore, charts are the best means to record the results of research for everyday practical shop use.

The shell-machining chart, Figs. 1 and 2, has been prepared for solving the problem of the most effective combination of cutting speed, feed, depth of cut, horsepower, and tool life for high-speed steel and sintered-carbide tools in the turning of shells made from S A E X-1335 steel. The chart applies to the ordinary roughing tool of the shape shown, when used with a cutting fluid supplied at the rate of five gallons per minute, as recommended in the Manual. When using carbide tools, it may be necessary, under certain conditions, to reduce the rake angle recommended in the Manual to from 6 to 8 degrees. In this case, the horsepower would increase approximately 4 per cent.

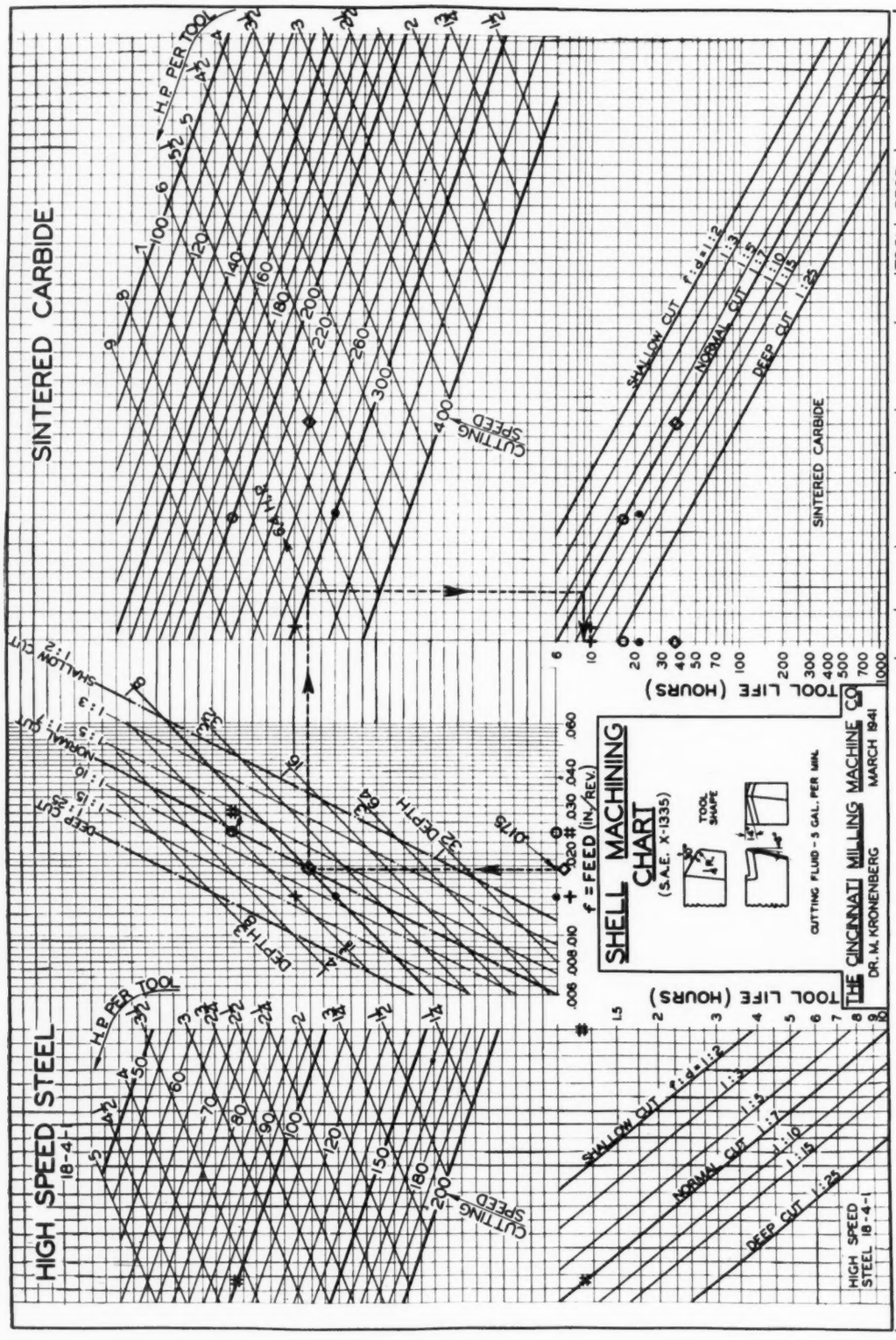
In the center of the chart, inclined lines represent the depth of cut, ranging from 1/32 to 3/8 inch. The horizontal scale gives feed rates from 0.006 to 0.060 inch per revolution. A second series of inclined lines, with greater slope than the depth-of-cut lines, gives the chip shape ratios (ratio of feed to depth) ranging from 1:2 to 1:25.

A chip having a depth of twice the feed is called a shallow cut, while a chip having a depth of twenty-five times the feed is called a deep cut. Between these limits lies the normal cut with a ratio of 1:7. Chip shape ratios between 1:5 and 1:10 are most commonly encountered in practice. The other ratios (1:3 and 1:15) are included to facilitate the use of the chart in intermediate cases.

The left part of the chart is used in the case of high-speed steel tools, and the right part when sintered-carbide tools are employed. In these two parts of the chart, cutting-speed lines and horsepower lines intersect each other. The "ratio lines" for the chip shape are repeated in the lower left and lower right sections as transfer lines leading to the tool-life scales. The chart can be used in different ways, either by beginning with assumed feed rates, as in Fig. 1, or with an available horsepower, as in Fig. 2, or with some other variable. The effect of varying the cutting conditions on the production factors will be demonstrated hereafter by several examples for both Figs. 1 and 2.

Use of Chart in Case of Assumed Feed Rates

Example 1—The dotted line on the chart, as seen in Fig. 1, shows an initial example with an assumed feed. Follow vertically the line from a feed of 0.0175 inch per revolution to the line for 1/8 inch depth of cut. It will be noted that at this point it also intersects the ratio line 1:7 (normal cut).



EXAMPLE NO.		FEED	DEPTH	RATIO	SPEED	TOOL	H. P.	TOOL LIFE	PROD. FACTOR
1	-- INITIAL EXAMPLE	.0175	1/8	1:7	300	SINT. CARB.	6.4	9	100 %
2	• DECREASE FEED	.014	1/8	1:7-1:10	300	SINT. CARB.	5.25	21	80 %
3	◇ DECREASE SPEED	.0175	1/8	1:7	240	SINT. CARB.	5.	38	80 %
4	+ DECREASE FEED, INCREASE DEPTH	.014	3/16	1:10-1:15	300	SINT. CARB.	7.	10	100 %
5	○ INCREASE FEED, DECREASE SPEED, INCREASE DEPTH	.024	3/16	1:7	200	SINT. CARB.	7.5	16	114 %
6	# INCREASE FEED, DECREASE SPEED, INCREASE DEPTH, TOOL CHANGE	.024	3/16	1:7	100	H. S. S.	3.7	1.2	57 %

EXAMPLES USING AN ASSUMED FEED RATE

Fig. 1. Examples of the Use of Shell-machining Chart when the Feed, in Inch per Revolution, is Assumed

From the point of intersection, follow the dotted line to the right to the selected cutting speed of 300 feet per minute. Interpolating between the horsepower lines, we note that 6.4 H.P. is required for the cut. Following the dotted line downward to the ratio line 1:7, in the lower right-hand part of the diagram, we find that the tool life would be 9 hours.

Example 2—Decreased Feed—Suppose that we want to determine the effect on horsepower and tool life of decreasing the feed to 0.014 inch per revolution, keeping the speed and depth of cut the same as in Example 1. The various intersecting points on the chart for Example 2 are represented by dots (·). Following the same procedure as in the previous example, we find that the shape ratio

is now between 1:7 and 1:10, the depth of cut remaining 1/8 inch. We further note that the dot on the 300 feet per minute speed line indicates a decrease in the required power to 5 1/4 H.P.; in the lower right-hand part of the chart we find that there is an increase in tool life to 21 hours.

If the production in Example 1 is called 100, then the production will be 80 in the present example, due to the reduced feed rate. The horsepower required, however, is reduced also, and there is an appreciable gain in tool life.

Example 3—Decreased Cutting Speed—In this example, we will reduce the cutting speed of Example 1 (300 feet per minute) to 240 feet per minute, retaining the feed and depth of cut given in the initial example. The present example is marked on the chart by a diamond symbol (◇). Starting at the 0.0175 feed rate, and proceeding vertically to the 1/8-inch depth of cut line, and from there horizontally to the 240 feet per minute cutting-speed line, we find that only 5 H.P. is required now. Proceeding downward to the normal shape ratio (1:7) line, we see that the tool life is increased to 38 hours. The production factor in this case, however, is 80.

Example 4—Decreased Feed, Increased Depth—Example 4 is marked by cross symbols (+). The feed is reduced to 0.014 inch per revolution and the depth of cut increased to 3/16 inch. The shape ratio is now between 1:10 and 1:15. Proceeding horizontally to the line for 300 feet per minute cutting speed, we find that the power required is increased to 7 H.P., while the tool life would be 10 hours.

Example 5—Increased Feed, Increased Depth, Decreased Speed—Example 5 refers to a feed advanced to 0.024 inch, a depth of cut increased to 3/16 inch, and a speed reduced to 200 feet per minute, as compared with the initial example. The present example is shown on the chart by means of circles (○). In this case, the horsepower consumption rises to 7.5, while the tool life increases to 16 hours. The production factor, considering the results in Example 4 as 100, is 114.

It should be noted that, in this example, the increase in the feed results in an *increase in production, even though the cutting speed has been reduced.*

Example 6—Increased Feed and Depth of Cut, and Decreased Speed with a High-Speed Steel Tool This example is marked on the chart by a double-cross symbol (#). This time we proceed from the feed-depth intersection horizontally to the left, namely, to the high-speed steel section of the chart. The horsepower consumption is 3.7 and the tool life 1.2 hours. The production factor, compared with Example 4, is 57.

In this case, the cutting speed must be decreased so much that it does not compensate for the increase in feed; therefore *the production decreases considerably.*

Use of Chart when Assuming a Given Horsepower

Suppose that two different machine tools are available. As indicated in Fig. 2, the first four examples refer to a machine capable of delivering 9 H.P. at the tools (3 H.P. for each of three tools); the second four examples refer to a machine with 15 H.P. at the tools (5 H.P. for each of three tools).

Assume the following problem: What are the cutting possibilities in turning the outside diameter of a 75-millimeter shell, made of S A E X-1335, using three tools and a depth of cut of 1/8 inch?

The longest distance traveled by any one tool is 3.55 inches; the forged diameter of the shell is 3.30 inches, and it is to be turned down to 3.05 inches.

Examples Involving 3 H.P. Available for Each Tool

With three tools acting simultaneously in a 9-H.P. machine, the power available at the cutting edge of each tool is 3 H.P. (Examples *A*, *B*, *C*, and *D*, Fig. 2.) Therefore, we start tracing along the 3-H.P. lines, either in the right or the left field of the chart, thus obtaining intersections with the various cutting-speed lines.

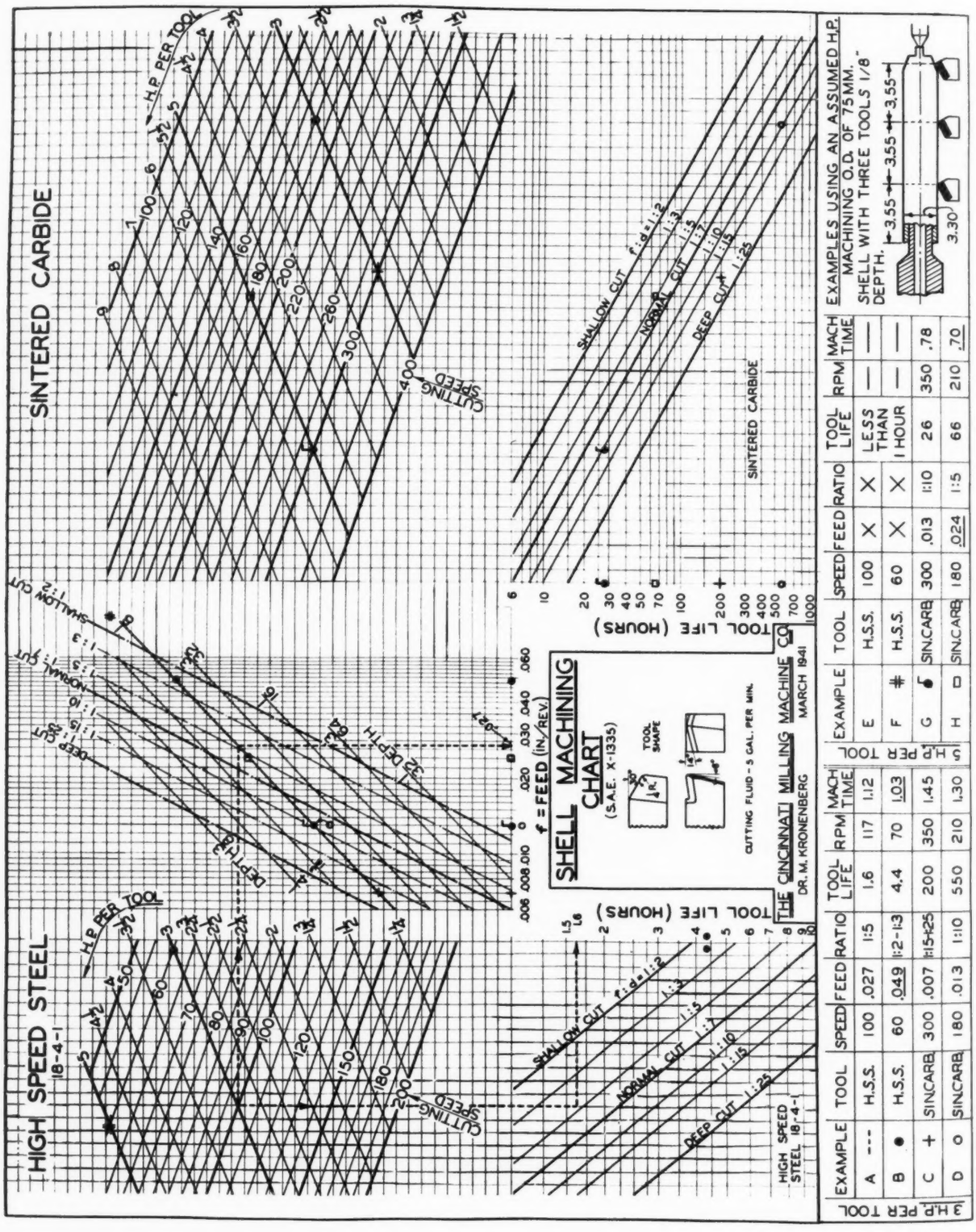
Example A—This example is indicated on the chart by a dotted line; the cutting speed is 100 feet per minute, using high-speed steel. From the point of intersection of the 3-H.P. line with the 100 feet per minute line, we proceed horizontally to the line for 1/8 inch depth of cut, noting that the shape ratio is close to 1:5. Continuing downward, we find that the feed is 0.027 inch per revolution; the tool life, again, we find at the left to be 1.6 hours.

The diameter of the work is 3.30 inches; we find the number of revolutions per minute of the spindle by dividing the cutting speed by 0.86 which is the circumference of the shell in feet. This gives 117 R.P.M. Then the machining time per shell is:

$$\frac{3.55}{0.027 \times 117} = 1.12 \text{ minutes}$$

Example B—The effect of *reducing the cutting speed* to 60 feet per minute is indicated by the example shown by dots (·). The shape ratio is between 1:2 and 1:3; a feed of 0.049 inch per revolution is necessary to utilize the available 3 H.P. per tool. The tool life increases to 4.4 hours, and the production time is reduced to 1.03 minutes per shell.

It will again be noticed that a lower cutting speed, combined with a larger feed, is more favorable both as to production time and tool life without requiring any greater power. (This is due to the fact that the specific cutting pressure decreases with increasing chip cross-sectional area, as found in metal-cutting research.) On the other hand, the increased feed affects the surface roughness and the cutting force. It is obvious that the forces acting on the machine and on the shell are increased



3 H.P. PER TOOL	EXAMPLE	TOOL	SPEED	FEED	RATIO	TOOL LIFE	RPM	MACH TIME
	A ---	H.S.S.	100	.027	1:5	1.6	117	1.12
	B ●	H.S.S.	60	.049	1:2-1:3	4.4	70	1.03
	C +	SIN.CARB.	300	.007	1:15-1:25	200	350	1.45
	D ○	SIN.CARB.	180	.013	1:10	550	210	1.30

TOOL PER HR	EXAMPLE	TOOL	SPEED	FEED	RATIO	TOOL LIFE	RPM	MACH TIME
	E	H.S.S.	100	X	X	LESS THAN 1 HOUR	—	—
	F #	H.S.S.	60	X	X		—	—
	G ♂	SIN.CARB.	300	.013	1:10	26	350	.78
	H □	SIN.CARB.	180	.024	1:5	66	210	.70

Fig. 2. Application of Shell-machining Chart when the Horsepower Available is Assumed. The Corresponding Feed, Tool Life, and Machining Time are Found from the Chart for any Cutting Speed Practicable for High-speed Steel or Sintered Carbide

considerably, as compared with Example *A*. There is a tendency for the machine to be deflected, and the accuracy of the turned shell will be decreased.

The cutting force can easily be calculated by means of the formula:

$$\text{Cutting force per tool, in pounds} = \frac{33{,}000 \times \text{H.P. per tool}}{\text{cutting speed, in feet per minute}}$$

Such a calculation reveals that the cutting force is 1000 pounds per tool in Example *A* and 1650 pounds per tool in Example *B*. Considering all three tools, the total force tending to cause deflection of the machine increases from 3000 to 5000 pounds; the horizontal components of this force, tending to deform and to dislocate the shell in its fixture and center, increase accordingly. *It is,*

therefore, important not to go to the extreme in the use of low speeds and large feeds.

Example C—This example applies to the use of *carbide tools* at a cutting speed of *300 feet* per minute, and is marked by cross symbols (+). It will be seen that the shape ratio is between 1:15 and 1:25, giving a feed rate of 0.007 inch per revolution. The tool life is 200 hours; the machining time 1.45 minutes per shell; and the cutting force only 350 pounds per tool.

Example D—In this example, marked by circles (○), the cutting speed is reduced to 180 feet per minute; the resulting feed is 0.013 inch per revolution, and the tool life is 550 hours. The machining time per shell is 1.3 minutes, and the cutting force 550 pounds per tool.

It will be noticed that, in these cases, the machining time with high-speed steel tools (Examples *A* and *B*) is better than that with carbide tools (Examples *C* and *D*), but, obviously, the machined surface, using high-speed steel tools, will be rougher, due to the high feed per revolution, and the deflection of the machine will be greater. Example *B* gives the maximum shell production for the 3-H.P. examples, but the finish may be too rough to meet the requirements. Example *A* gives a production 8 per cent less than *B*, but the finish will be better. The tool life, however, is low—1.6 hours—but this may be satisfactory if the time required for tool changing is small.

Examples Involving 5 H.P. Available for Each Tool

Example E—This example refers to high-speed steel tools with 100 feet per minute cutting speed. It will be noted that the intersection of the 5 H.P. line and the 100 speed line is outside of the chart. This indicates that the combination does not give practical results. The tool life, for example, would be only 12 minutes.

Example F—The result of reducing the speed to 60 feet per minute is shown in this example, marked by double-cross symbols (#). The feed rate at 1/8 inch depth of cut lies also outside the chart (that is, outside the feed scale), thus showing that the resulting feed would be too large for practical purposes. Consequently, high-speed steel tools would not be suitable to use when 5 H.P. per tool is available.

Example G—In this case, we are using sintered-carbide tools at 300 feet per minute, as indicated by the winged dot (♪). This shows a feed rate of 0.013 inch per revolution, and a tool life of 26 hours. The machining time is 0.78 minute per shell; the cutting force per tool is 550 pounds.

Example H—In this example, marked by a square (□), we reduce the cutting speed to 180 feet per minute, as compared with Example *G*. With 5 H.P. per tool, we find that the feed rate is 0.024 inch per revolution; the tool life, 66 hours; and the machining time, 0.70 minute per shell.

Example *H* gives the best result obtained in any of the examples. A feed rate of 0.024 inch is not considered too great, involving a cutting force of 920 pounds per tool. The tool life is also quite satisfactory.

General Conclusions

It is not assumed that this shell-machining chart represents the "last word," but it is believed that it will be useful, especially if employed as a basis for exchanging experiences in shell machining. It might be worth while to clear such an exchange through, for example, an office of the Ordnance Department, thereby making it possible to advise manufacturers of the best performance figures in shell production.

From the examples given, it may be concluded that, in general, the maximum shell production depends on the horsepower available at the cutting edge, and on the cutting speed the tool can stand. Maximum results are obtained by using high-powered machines at high speeds. The higher the power, the shorter the production time. The power, however, should be used at a speed high enough to permit reasonably low feeds, with relatively small forces and deflections. The feeds should, on the other hand, not be too low, since that would increase the production time.

The examples indicate that carbide tools are useful on high-powered machines, since they permit high cutting speeds with reasonable feeds. High-speed steel tools are preferable in the case of many of the low-powered machine tools which are immediately available in shops all over the country.

* * *

Industry and Defense Exposition in Cincinnati

What is to be known as the Miami Valley Industry and Defense Exposition is planned to be held in Music Hall, Cincinnati, Ohio, from May 28 to June 8. This is the first exposition that will emphasize America's intensified preparations for defense. The exhibit will not show a display of actual machines, since every machine tool is needed in the war material factories, but instead, illustrations of various kinds will help to explain the place of the machine tool industry in relation to the industries manufacturing war materials.

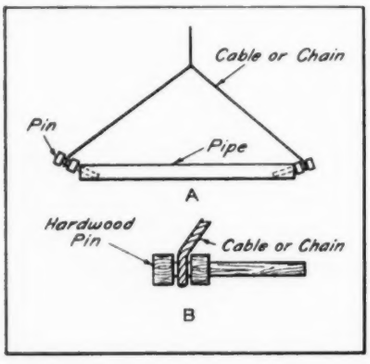
In addition to these exhibits, booths will be used to show plans for and results of various training programs, the expansion of production facilities, military, naval and aviation equipment, etc. A theater will be set up to show industrial films. The exposition is being supported by outstanding industrial concerns in the Miami Valley district, and is expected to prove of considerable educational interest and value.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Kink for Protecting Pipe Threads in Machine Shop

When heavy pipe or machine shop equipment with threaded ends is being handled by mechanical means, it is customary to use steel hooks on the ends of the lifting cable, chain, or rope. The hooks are placed in the open ends of the pipe or in any convenient opening. This often results in battering or damaging the threads. If the pipe is provided with couplings or other internally threaded fittings, the internal threads are almost certain to be damaged to some extent. Even when the threads are on external surfaces, they are frequently damaged. Whenever this happens, considerable time is consumed by the pipe-fitters in repairing the damage or in forcing the threaded members in the assembling operation. Frequently, leakage results from pipe threads that have been damaged as described.



Method of Using Hoisting Cable Equipped with Hard Wood Pins to Avoid Damaging Pipe Threads

The view at *A* in the accompanying illustration shows a method of handling pipe that prevents the thread from being injured. Two hard wood pins, turned as indicated in the view at *B*, prevent the metal from coming in contact with the threads. The ends of the wooden pins are simply inserted in the open ends of the pipe, as shown, for hoisting. Of course, this method is not applicable to all equipment, but it will be useful in solving many work-handling problems.

W. F. SCHAPHORST
Newark, N. J.

Methods Used in Dressing Wheels for Toolpost Grinding

In performing external cylindrical, internal cylindrical, and rotary surface grinding operations on a lathe with a toolpost grinder, it is necessary to employ individual dressing methods that will insure having the wheel make contact with the work along its entire face rather than at either corner. The method illustrated in Fig. 1 for dressing the wheel used for external cylindrical grinding is now in common use.

It consists of positioning the diamond-holder crosswise on a cylindrical bar held securely between the lathe centers. This bar should be finished as accurately as possible with respect to straightness, so that it can be used for aligning the lathe centers before dressing the wheel. Aligning the centers in this manner will assist in obtaining a straight surface on the work. This procedure, however, does not solve the problem of dressing the wheel properly for internal and rotary surface grinding.

Only the headstock and carriage are employed in performing internal and rotary surface grinding operations, no use being made of the tailstock. Thus, in dressing the grinding wheel for internal grinding, the truing diamond nib is positioned crosswise in a holder which, in turn, is fitted to the lathe spindle, as shown in Fig. 2. This holder also has the end bored to an angle of 5 degrees to fit the diamond-holder when set for dressing wheels for rotary surface grinding (see Fig. 3).

The angular position of the bore for the diamond-holder used in truing wheels for rotary surface grinding coincides with that employed for the other truing set-ups, so that the diamond point can be located below the center line, as shown in Fig. 3, to avoid a blunt contact with the wheel face.

BERNARD T. COOK
Springfield, Mass.

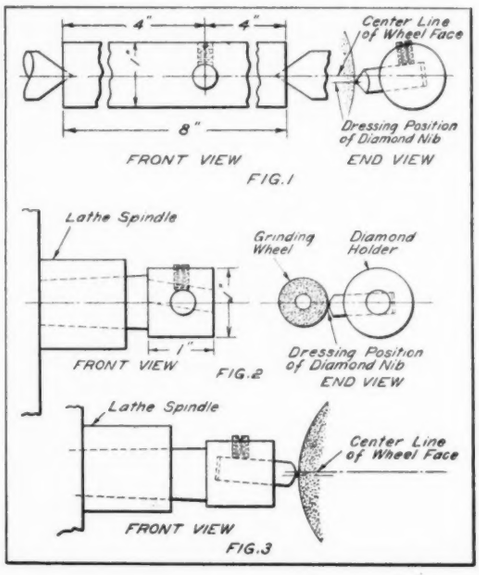
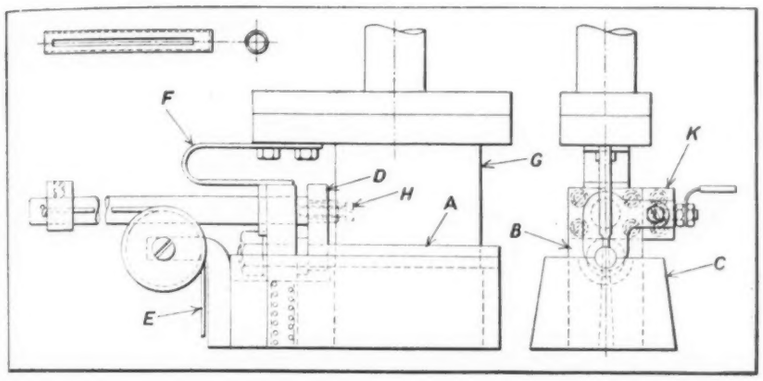


Fig. 1. Equipment for Dressing Toolpost Grinder Wheel for Cylindrical Grinding. Fig. 2. Dressing Wheel for Internal Cylindrical Grinding. Fig. 3. Truing Wheel for Rotary Surface Grinding

Electrically Operated Safeguards for Press Tools



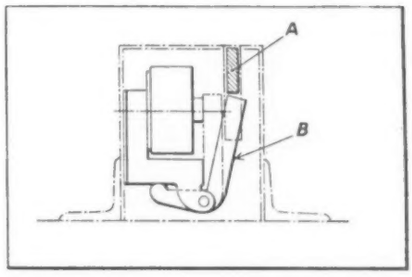


Fig. 1. (Left) Piercing Tool with Electric Safeguard. Fig. 2. (Above) Safety Catch for Press Pedal

S press tools are expensive equipment and may easily be damaged, some means of safeguarding them is essential. Multiple tools are particularly susceptible to damage through small displacements resulting from unavoidable causes. Tool wear, a slight change in the hardness of the material, or even an excess of lubricant may cause trouble, which, if further damage is to be avoided, necessitates the immediate stopping of the press. Electrically operated devices provide a simple and inexpensive means of safeguarding press tools, either by stopping the press, if necessary, or, in the case of hand-fed tools, by making it impossible for the operator to start the press unless the correct procedure has been followed.

An example of a device falling in the second class is shown in Fig. 1. This tool, which is intended for mounting on a small power press, pierces the longitudinal slot in the tubular casing shown in the upper part of the illustration. The method of operation is as follows: The casing to be pierced is pushed by the operator over the mandrel *A* carried by slide *B* which moves vertically in die-block *C*. When the punch is at the top of its stroke, the slide is raised clear of the die-block by a spring to enable the pierced casing to be ejected by ejector *D*. The ejector is operated by cords *E* which are connected to a pedal actuated by the operator's foot. When the punch *G* descends, the slide and mandrel are firmly pressed down by spring *F* before the actual piercing is performed.

Providing Automatic Protection

When the tool was first put into operation, several accidents occurred, owing to the fact that the ejector was not pushed all the way back to its original position before tripping the press. The cost of maintenance was, therefore, considerable, and there was always the risk of a portion of the tool flying

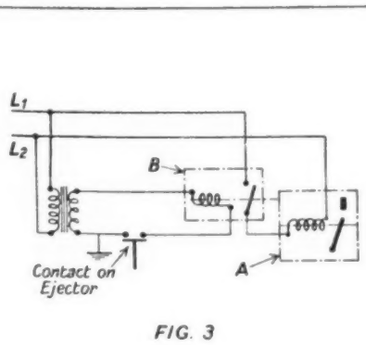


Fig. 3. Wiring Diagram for Safety Device which is Illustrated in Fig. 1

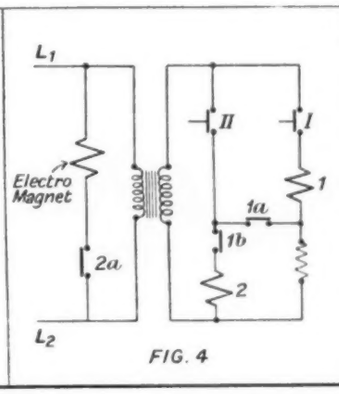


Fig. 4. Circuit Diagram that Insures Performing Two Operations in Correct Sequence

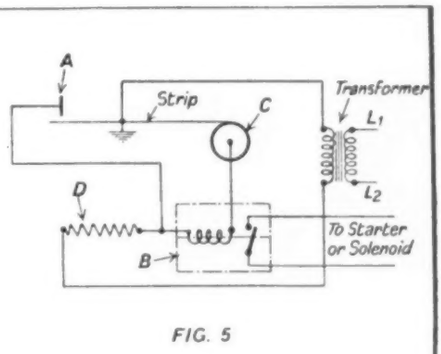


Fig. 5. Wiring Diagram for the Automatic Press Stopping Arrangement Shown in Fig. 6

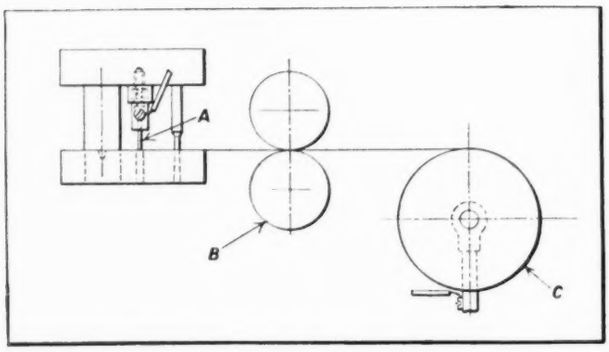


Fig. 6. Press Tool Arranged to Stop the Machine in Case of Punch Breakage or Exhaustion of Strip Stock Supply

and injuring the operator. Consequently, it was decided to fit the tool with an electrically operated safety device that would make it impossible to trip the press unless the ejector was in the proper position and, incidentally, would insure that the work was located correctly. To this end, the ejector was provided with a projection carrying a screw *H*, which, when the ejector is pushed back completely, makes contact with a phosphor-bronze strip attached to an insulating block *K*, thus completing an electrical circuit through the tool itself to which one connection is made.

The safety catch used is shown in Fig. 2. It consists of a standard clapper type electromagnet mounted in a sheet-metal case and fixed to the floor under the press. A slot in the case accommodates the press trip-pedal *A*. When the magnet is not energized, the pedal is prevented from being depressed by clapper *B*. When the circuit is completed by the ejector on the tool, the magnet is energized, thus drawing the clapper up to the vertical position and allowing the operator to depress the pedal.

The electrical circuit is shown in Fig. 3. The electromagnet *A* forming the safety catch is connected to the supply line to enable a standard unit to be used, and it is, therefore, necessary to introduce a relay *B*, so that the contacts on the tool can be operated at a safe low voltage. The current for the relay is supplied by a small transformer which delivers about 8 volts.

This tool had been provided with a safety guard before the safety device just described was applied; but had this not been done, it would have been an easy matter to fit two push-buttons, one on either side of the press, in series with the ejector contact, so that the operator would have had to use both hands to press them before the press could be tripped.

Controlling Sequence of Operations

Another example of an electric safeguard is an arrangement to insure that two operations are carried out in a predetermined sequence. The circuit diagram is shown in Fig. 4. Two contacts are provided, arranged so that they are closed by an appropriate part of the tool mechanism when the operation is performed. These contacts are marked I and II. When the operations are performed in the correct sequence, the closing of contact I causes relay 1 to be energized, thus breaking contact 1*a* and closing contact 1*b*. This enables the circuit, through relay 2, to be completed when contact II is closed as a result of performing the second operation.

If the operations are not carried out in the correct sequence and contact II is closed first, relay 1 will be short-circuited through the resistance, and neither of the relays will be energized, even if contact I is subsequently closed.

The automatic operation of multi-stage press tools on an unattended press is something of a gamble, as the savings may be eaten up in increased tool-maintenance charges, due to parts sticking and delicate tools breaking, thus causing serious damage if the press is not stopped in time. The means adopted to insure that irregularities will be detected must, of course, vary with the particular tool, while, to stop the press, it may be sufficient to trip the motor, or, if an instant stop is essential or the press is driven from a lineshaft, a solenoid-operated trip can be employed.

Detecting Irregularities in Automatic Press Operation

There are two general methods of detecting irregularities. The first employs light-sensitive relays and lamps, appropriately positioned to insure that the press will be stopped before the next operation can take place, in case any part sticks on the ram. With this system, the contacts of several photo-electric relays are connected in series, so that the establishment of a light beam between any one of the light sources and its corresponding photo-tube serves to de-energize a solenoid and trip the clutch of the press. As a further protection, the light sources are also series-connected, so that a failure in the lighting current brings the machine to rest. A push-button is so located that the operator can stop the machine at will.

The other method makes use of contacts which, when actuated as a result of specified irregularities, operate the press-stopping mechanism. An example is shown in Fig. 6. This is a simple blanking and piercing die to which the strip stock is supplied by a roll-feed *B* from a reel *C*. The object, in this case, is to insure that the press will stop if the piercing punch breaks or the supply of material runs out.

If the piercing punch should break, pin *A*, which is spring-loaded and carried on an insulating base, strikes the strip instead of passing through the pierced hole, thus completing an electrical circuit. When the strip is exhausted, the connection between the reel and the press is broken, another circuit being thus interrupted.

Referring to the circuit diagram in Fig. 5, it will be seen that a relay *B* is so arranged that it is en-

ergized when the conditions are normal, the main relay contact being connected in the under-voltage release circuit of the motor starter or, if the latter is of the push-button type, in series with the "stop" push-button. When the pin or dummy punch *A* makes contact with the strip, it short-circuits the relay, resistance *D* limiting the current. When the strip runs off reel *C*, the relay circuit is interrupted. In either case, the relay is de-energized and the starter circuit broken.

If it is desired to trip the press, the relay contact should be of the normally closed type, so that the solenoid tripping the clutch will be energized in an emergency. A subsidiary switch actuated by the clutch-operating rod can be fitted to cut out the solenoid as soon as it has operated.

Westinghouse Annual Machine Tool Forum

THE sixth annual machine tool electrification forum, held at the East Pittsburgh plant of the Westinghouse Electric & Mfg. Co., April 14 to 16, was attended by more than 110 engineers and machine tool designers, representing over seventy of the leading machine tool builders throughout the country. The fact that the attendance at the 1941 meeting was greater than in any previous year, in spite of the present activity in machine tool plants, emphasizes the growing importance of the cooperation between the electrical and machine tool industries in the solution of design and production problems. Sessions were held morning and afternoon for three days. All the papers read had direct application to the problems of the machine tool industry, and most of them related to the application of electrical equipment to machine tools.

The engineers attending the forum were welcomed at the opening session by L. F. A. Mitchell, manager of the Westinghouse machinery electrification section. R. S. Kersh, of the same section, was in charge of the forum and presided as chairman throughout the three-day meeting. Tell Berna, general manager of the National Machine Tool Builders Association, speaking to the assembled group at the first session, stressed the urgent importance of everyone's contribution toward machine tool production during the present national emergency. R. H. Clark, electrical engineer of the Warner & Swasey Co., spoke on "Standardization of Electric Apparatus Installation," and A. H. Heywood, manager of the Westinghouse motor and generator sales section, described the changes that have taken place in redesigning small motors, and their effect on machine tool building. His paper was entitled "New Motors and the Machinery Manufacturer." T. C. Fockler, engineer of the motor division, discussed "Comparative Methods of Dynamic Balance Measurement."

Howard Dunbar Spoke on Machine Tool Production in Relation to Defense

One of the highlights of the forum program was a confidential address on machine tool production problems in their relation to national defense, made by Howard Dunbar, technical chief of the Machine Tool Section of the Office of Production Management, Washington, D. C., who is also vice-president and general manager of the Norton Co., Worcester, Mass. At the same session, G. A. Spohn, electrical engineer of the General Machinery Corporation, spoke on "Machine Tools for Big Guns," and J. R. Weaver, manager of the new Westinghouse Louisville Ordnance Division, spoke on "Westinghouse Activities in National Defense."

During the Tuesday afternoon session, Philip McKenna, president of the McKenna Metals Co., spoke on "Steel Cutting Carbide Tools—Their Design and Power Requirements." Dr. H. B. Osborne, research and development engineer for the Ohio Crankshaft Co., explained the principles underlying the equipment used for induction heating for surface hardening. The last paper of the day was on "Alternating Current Power Distribution Systems for Industrial Plants," by G. A. Caldwell, industrial engineer of the Westinghouse company.

During the last day of the meeting, H. G. Keller, engineer of the Link-Belt Co., spoke on "Mechanical Devices for Infinitely Variable Speed," and S. G. Leonard, electrical engineer of the Fellows Gear Shaper Co., stressed the development of "Electricity in Machines for Manufacturing Gears." Finally, O. G. Rutemiller, Westinghouse Detroit division engineer, spoke on "Wiring Arrangements for Direct-Current Control Functions." The afternoon of the last day was devoted to an open forum and discussions of various subjects suggested by the visiting engineers.

Demonstration of Large Boring Mill Was a Feature of the Meeting

One of the interesting events of the meeting consisted of an inspection of the 40-foot boring mill, one of the world's largest, which was recently installed at the East Pittsburgh works. G. A. Spohn, of the General Machinery Corporation, and W. S. Oswald, of the Westinghouse generator division, had collaborated on a description of this machine, giving the visiting engineers a comprehensive idea of this unusual machine tool. At the time, the huge boring mill was machining stator frames for some of the large water-wheel generators now being built for the power projects under way in various parts of the country.

MATERIALS OF INDUSTRY

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Hipersil—A New Silicon Steel of High Permeability

A new silicon steel of high permeability, known as Hipersil, has been developed jointly by the Westinghouse Electric & Mfg. Co. and the American Rolling Mills Co. This steel has proved to have great advantages in transformer core construction. The flux-carrying capacity of the new magnetic steel is about one-third greater than that of ordinary silicon steel. This makes it possible to reduce the size and weight of the transformers as much as 25 per cent in some sizes.

In transformer units smaller than 25 K.V.A. the voltage regulation is improved and the short-time overload capacity of the transformers is increased. In single-phase units, maintenance is simplified by a new type of wound core to which this material is adapted. Three-phase units have cores similar to those now used in conventional design. The new steel costs about twice as much, on a pound for pound basis, as ordinary hot-rolled silicon steel, but the advantages outweigh this extra cost. It is now being used exclusively for transformer core construction by the Westinghouse company.

One application, for example, is for transformers mounted on poles. About the largest single-phase transformer of the conventional type that can be mounted on a pole is 75 K.V.A. With Hipersil, such a unit can be replaced by a 100-K.V.A. transformer. Similarly, prevailing practice limits the size of three transformers hung an a single crossarm to about 37.5 K.V.A. each, but with the new material, this can be increased to 50 K.V.A....201

Waterproof Packing Material for Metal Parts

For use in protecting metal parts and products against rain, hail, snow, or moisture, a new waterproof form of "Corroflex" packing material has recently been placed on the market by the Sherman Paper Products Corporation, Newton Upper Falls, Mass. This new material consists of basic "Corroflex," (a flexible corrugated packing with criss-cross indentations) to which has been added a duplex sheet with asphalt lining. This not only makes the packing waterproof, but also increases its strength and resistance to puncturing, abrasion, and breakage. The material is available in rolls 6 to 72 inches wide and in sheets cut to size...202

Light-Weight Armor Plate for Airplane Construction

A light-weight alloy material known as "Colalloy Armorplate" has recently been introduced by the Colonial Alloys Co., E. Somerset and Martha Sts. and Trenton Ave., Philadelphia, Pa. The outstanding characteristic of this armor plate is that it weighs about 50 per cent less than steel, and is thus particularly applicable to airplane construction. The surface of the new armor plate is claimed to have a hardness much greater than that of ordinary armor plate. It is available in any thickness up to 3 inches, with the hard surface extending to any depth from 0.001 inch to 1/4 inch.

One of the major factors influencing projectile penetration is the heat generated by friction when the projectile passes through the armor plate. Colalloy Armorplate is claimed to have a rate of heat dispersion which is several times greater than that of steel armor plate, thus tending to materially lessen the penetration of projectiles. Another advantage of this material is its hard, highly polished surface, which will not deteriorate, due to resistance to corrosion and oxidation. This glassy smoothness tends to make a bullet glance or slide off, thus preventing it from "biting" into the metal. The new armor plate is also claimed to have a marked resistance to ice formation.

In using Colalloy Armorplate, production bottlenecks can be avoided, it is stated, since each aircraft factory can have its own processing plant, and heat-treating operations or expensive equipment are unnecessary. This material is intended for use in the construction of propellers, wings, fuselages, exposed engine parts, pontoons, struts, gas tanks, landing gear, pilot-house structure, and for other vital parts requiring armored protection.

To obtain additional information about materials described on this page, see lower part of page 154.

It can be supplied in many forms, such as sheets, plates, tubes, angles, and rods to suit individual production requirements. 203

Extruded Plastic Shapes Developed to Save Aluminum

A new line of extruded plastic shapes has been introduced under the trade names "Plastikmould" and "Plastiktrim" by the R. D. Werner Co., Inc., 380 Second Ave., New York City. These new products are manufactured in a wide range of colors and in the same shapes and sizes as are available in aluminum. They are intended to meet the demand for such products as cannot be supplied by the aluminum industry, due to the priority demands of the National Defense Program. Rods, tubes, and other commercial parts, both flexible and rigid, are also available..... 204

Low-Temperature Welding Rods and Fluxes

Rods and fluxes for the oxy-acetylene welding and brazing of all metals at unusually low temperatures have been placed on the market by the Weldoloy Mfg. Co., 3 Park Place, New York City, under the name of Weldoloy. Various types are available for handling different classes of work. For welding cast iron, filling up blow-holes, and building up new material on worn-out parts of gray iron castings, Type CI-514 Weldoloy rod is suitable. The fusing temperature is 1500 degrees F., and the tensile strength of the weld is 47,000 pounds per square inch. The material is medium hard, with good machining qualities, and has the color of cast iron. It is claimed that because of the low fusing temperature of this rod, welding can be accomplished without warping or internal stresses, which may be of value in permitting repairs to be made without dismantling machines.

For the butt-welding of steel, stainless steel, chromium-nickel steel, molybdenum and vanadium steels, Carboloy and tungsten-carbide alloys, mild steel, and malleable cast iron, Type ST-516 rod is used. This type of Weldoloy has a fusing temperature of 1350 degrees F., a weld tensile strength of 110,000 pounds per square inch and a silver-white color. Owing to its excellent flowing ability and high tensile strength, it is claimed to be particularly suitable for welding thin steel sheets and tubing such as are used in airplane manufacture.

For building up new materials on worn-out parts of steel, cast iron, copper, brass, bronze, and nickel alloys, Type BU-685 Weldoloy is recommended. This material, which is bronze color, has a fusing temperature of 900 degrees F., a tensile strength of 100,000 pounds per square inch, and a Brinell hardness of 235. It is non-corrodible, has a low coefficient of friction and can be highly polished. This type rod is especially recommended for repairing bearings, axles, guide faces, valve seats, ship propellers, etc.

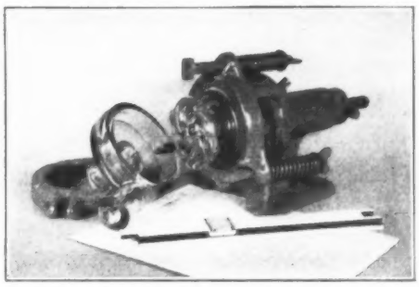
Other Weldoloy welding rods available are Type BB-518 for welding brass, bronze, copper, aluminum-bronze, and nickel, and for welding copper alloys to iron, galvanized iron, and steel; Type WM-688 for welding white-metal die-castings; Type SA-690 for welding sheets and tubes of aluminum and its alloys; and Type CA-710 for welding aluminum castings and also for building up new material on worn-out parts. 205

Hancodur—A Self-Lubricating Alloy of Great Tensile Strength

A long-wearing alloy known as "Hancodur," to be used for valve stems and bonnets, has been developed by the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. This is a self-lubricating alloy. It is stated that repeated breakdown tests indicate that valve stems and bonnets made from the new alloy outwear other stems and bonnets six times. Hancodur has a tensile strength of 90,000 pounds per square inch. 206

Pump with Glass Parts for Corrosive Liquids

A 3/4- by 1-inch pump made of Pyrex glass, with a capacity of 10 gallons per minute, has been placed on the market by the Nash Engineering Co., South Norwalk, Conn. This pump was developed as the result of cooperation with the Corning Glass Works, Corning, N. Y., and is similar in construction to the somewhat larger model first produced. The volute, head, and rotating impeller are constructed of glass, so that corrosive liquids or liquids that must be kept chemically uncontaminated can be safely handled. A specially designed mechanical seal replaces the conventional stuffing-box, and a safety unloading device eliminates the possibility of any fracture of the glass casing. This pump will handle both hot acids and brine-cooled liquids with equal facility. 207



Volute, Head, and Rotating Impeller of This Novel Pump are Constructed of Glass to Resist Corrosive Liquids

To obtain additional information about materials described on this page, see lower part of page 154.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at bottom of page 153 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the May Number of MACHINERY

Turret Lathe Tools

GISHOLT MACHINE CO., 1209 E. Washington Ave., Madison, Wis. Catalogue covering the complete line of 164 Gisholt turret lathe tools for use on ram and saddle type turret lathes. The dimension drawings shown are large enough to permit direct scaling to lay-out sheets. Turret lathe users can obtain copies of the catalogue without cost by writing on company letterhead, listing the make and model of machine used and the writer's title or occupation. Others, including students and teachers, can obtain copies by sending $2.50 to defray cost of printing and mailing. 1

Grinding Equipment

NORTON CO., Worcester, Mass. Booklet "Grinding and Finishing with Portable Equipment," containing information on the use of portable grinders in various industries, and data on types and sizes of grinding wheels for this equipment. Booklet entitled "Disk Grinding," showing many different applications of Norton disk grinding machines, and containing data on the types of wheels used for various classes of work. 2

Charts for Apprentice Training

ATLAS PRESS CO., Kalamazoo, Mich., is distributing three charts entitled "Lathe Cutting Tools," "Thread Forms and Formulas," and "Sixty-Degree V-Type Thread Dimensions" for use in connection with apprentice training courses. Apprentice directors and industrial instructors can obtain copies by sending 10 cents to the Atlas Press Co., to cover handling and mailing expense. 3

Contour Machines

CONTINENTAL MACHINES, INC., 1312 S. Washington Ave., Minneapolis, Minn. Catalogue entitled "The World's Fastest Precision Method of Removing Metal," prepared especially for use in trade and vocational schools, training centers, etc. Specification sheets on various types of DoAll contour metal-shaping machines are included. 4

Inspection Equipment

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford, Conn. Circular 441-1, illustrating and describing Pratt & Whitney standard measuring machines for determining the accuracy of gages, tools, and parts. Circular 460, on P & W Trusform adjustable-limit snap gages. 5

Automatic Aircraft Riveters

CHICAGO RIVET & MACHINE CO., 1830 S. 54th Ave., Chicago, Ill. Catalogue illustrating and describing automatic riveting machines, of both bench and pedestal types, especially designed for setting aircraft rivets. Limited number of copies are available to executives of aircraft assembly manufacturing plants. 6

Kennametal Tools and Blanks

MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Catalogue 41, listing specifications and prices for five styles of Kennametal blanks, twenty-eight standard Kennametal tools, and several semi-standard tools, as well as lathe and grinder centers supplied with Kennametal nibs. 7

Fabricated Masonite

SERVICE INDUSTRIES, INC., 2035 Calumet Ave., Chicago, Ill. Catalogue entitled "Fabricating to Specifications with Industrial Masonite—the Board of 1000 Uses." This material is applicable in the metal trades for making dies for spinning sheet metal, especially aluminum and its alloys. 8

Tool Inspection Equipment

ILLINOIS TOOL WORKS, 2501 N. Keeler Ave., Chicago, Ill. Circular entitled "Taking the Guesswork Out of Tool Inspection," illustrating and describing the precision measuring machines built by the company for accurately checking the sharpening of hobs, milling cutters, and shaper cutters. 9

Precision Boring Machines

EX-CELL-O CORPORATION, 1200 Oakman Blvd., Detroit, Mich. Series of folders (Nos. 31101, 31201, 31301, 31401, and 31501) on five standard Ex-Cell-O precision machines for boring, turning, facing, etc., made in single- and double-end styles. 10

Carboloy Tools and Blanks

CARBOLOY COMPANY, 11147 East Mile Blvd., Detroit, Mich. Catalogue GT-129, covering the complete expanded standard tool line of the company, including prices and specifications of Carboloy standard blanks, available in two styles, sixty-five sizes and three grades. 11

Grinding Wheels and Abrasives

ABRASIVE CO., DIVISION OF SIMONDS SAW AND STEEL CO., Philadelphia, Pa. Illustrated plant view book, showing in detail the various manufacturing processes and plant facilities used by this company in the production of grinding wheels and abrasive materials. 12

Meehanite Castings

MEEHANITE RESEARCH INSTITUTE OF AMERICA, INC., 311 Ross St., Pittsburgh, Pa. Bulletin 12, entitled "Design with Confidence—Take Advantage of Controlled Physical Properties," illustrating and describing twelve widely varying industrial applications of Meehanite castings. 13

Portable Belt Lacer

CLIPPER BELT LACER CO., Grand Rapids, Mich. Folder describing a portable belt lacer of new design which permits thousands of pounds of pressure to be exerted at the jaws, so that the belt hooks can be easily embedded flush with the surface of the belt. 14

Cleaning Equipment

AMERICAN FOUNDRY EQUIPMENT Co., 399 S. Byrkit St., Mishawaka, Ind., is distributing a new house organ known as the "American Wheelabrator Digest," devoted to better metal-cleaning methods and recent developments in metal-cleaning equipment. 15

Ampco Metal Selector

AMPCO METAL, INC., Milwaukee, Wis. Cardboard slide selector for quickly determining the physical properties and chemical composition of all grades of Ampco metal. On the reverse side of the device is a table listing the general uses of the alloy by grades. 16

Gear Beam Compass

A. P. BARTUSCH, 775 Walnut St., Lockport, N. Y. Circular illustrating and describing a new all-metal beam compass that is quickly adjustable to the desired radius by a rack and gear control and is adapted for paper drawing and metal scribing. 17

Cooling Fluids

OAKITE PRODUCTS, INC., 26 Thames St., New York City. News Service Bulletin dealing chiefly with "The Grinding Process and Its Dependence on Efficient Cooling," giving data on proper coolants to insure accuracy, speed, and economy in grinding. 18

V-Belt Data Book

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J. Condor V-belt engineering data book (fourth edition), covering standard drives, sheave factors, and other data of value in designing new or special drives. 19

Die-Casting Machines

G & N MFG. CO., 11610 Madison Ave., Cleveland, Ohio. Catalogue descriptive of G & N hydraulic die-casting machines, including a combination machine for zinc-tin-lead and aluminum-brass-magnesium applications. 20

Metal-Cutting Lubricants

SULFLO, INC., 1143 E. Jersey St., Elizabeth, N. J. Circular on metal-cutting lubricants, containing a table showing the particular grades of lubricant most suitable to use for various machining operations on different kinds of metals. 21

Multiple V-Belt Drives

FORT WORTH STEEL & MACHINERY CO., Fort Worth, Tex. Data book covering V-belt drive applications, including "Boltrim" V-belt sheaves and "Goodflex" multiple V-belts. Contains detailed data and complete specifications. 22

Steam Cleaning Machines

HYPRESSURE JENNY DIVISION OF HOMESTEAD VALVE MFG. CO., Coraopolis, Pa. Circular illustrating and describing a new Hypressure Jenny super-capacity steam cleaner for industrial use. 23

Open-Hearth Furnace Pressure-Control System

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Bulletin 27-5, illustrating and describing the Brown open-hearth furnace pressure-control system and its application. 24

Honing Machines

W. F. & JOHN BARNES CO., Rockford, Ill. Circular describing the use of the Bore-Hone for machining airplane-engine cylinders, gun tubes, and other work requiring precision boring, honing, and drilling. 25

Welded-Steel Baseplates

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Booklet 1882, covering the Link-Belt line of welded-steel baseplates for adjusting pillow blocks and flat boxes for shaft alignment. 26

Clutches

ROCKFORD DRILLING MACHINE DIVISION, BORG-WARNER CORPORATION, 310 Catherine St., Rockford, Ill. Circular descriptive of the Rockford LMC clutch for use with gasoline or other motors. 27

Electric Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Descriptive Data 15-075, on planer limit switches. Descriptive Data 3706.1, on fan-cooled, explosion-resisting motors. 28

To Obtain Copies of New Trade Literature

listed on pages 152-154 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

Hydraulic Control

REEVES PULLEY CO., Columbus, Ind. Folder describing the Reeves hydraulic automatic control, which is used in connection with the Reeves variable-speed transmission to obtain completely automatic variable-speed control. 29

Ball-Bearing Practice

MARLIN-ROCKWELL CORPORATION, Jamestown, N. Y. Bulletin 9 (in a series on "Ball Bearing Practices for the Shop Man"), entitled "Instructions for Removing Bearings from Shaft." 30

Variable-Speed Transmissions

GRAHAM TRANSMISSIONS, INC., 2711 N. 13th St., Milwaukee, Wis. Manual 501, describing Graham variable-speed transmissions, some of which have a reversing feature.... 31

Links and Levers

BRE MFG. CO., 5309 Sixth Avenue, Brooklyn, N. Y. Circular containing dimensions and list prices of the various sizes and forms of links and levers made by this company. 32

Oilers with Removable Filter

TRICO FUSE MFG. CO., 2950 N. 5th St., Milwaukee, Wis. Bulletin 26-A, describing a new line of Trico dust-proof gravity-feed oilers with a removable oil filter. 33

Welding Rods and Fluxes

WELDOLOY MFG. CO., 3 Park Place, New York City. Pamphlet describing Weldoloy rods and fluxes for the low-temperature welding and brazing of all metals. 34

Drafting Machines

DRAFTO CO., 182 Walnut St., Cochranton, Pa. Folder describing the Master-Drafto Model No. 60 low-priced drafting machine. 35

Lighting Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Leaflet F-8604, describing 100-watt fluorescent luminaires for industrial lighting. 36

Boring Mills

CINCINNATI PLANER CO., Cincinnati, Ohio. Bulletin 130, descriptive of Cincinnati "Hypro" 54- by 64-inch vertical boring mills. 37

* * *

Prizes for Papers on Resistance Welding

Cash prizes totaling $700 are offered again this year for technical papers on resistance welding, in a contest sponsored by the Resistance Welder Manufacturers Association, 505 Arch St., Philadelphia, Pa. The contest closes August 31, 1941. Complete information can be obtained from the Association, or from the American Welding Society, 33 W. 39th St., New York City, which will award the prizes at its annual convention, to be held in Philadelphia, October 20 to 24.

Revised Commercial Standard for Gage Blanks

A revised standard for gage blanks has just been released by the National Bureau of Standards, Washington, D. C., under the title "Gage Blanks (Third Edition) Commercial Standard CS8-41." This has been accepted by producers and users of gages on the recommendation of the American Gage Design Committee. The revision recognizes the progress in gaging practice since 1933 by incorporating new standards for thread plug gages, taper thread ring gages, dial indicators, and master disks. Standard designs are also given for many other types of gages, and the former data on adjustable length gages have been completely revised. Copies of the new standard are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15 cents.

* * *

Portable Drill Standard

The Bureau of Standards, Washington, D. C., announces that a commercial standard for portable electric drills, exclusive of high-frequency drills, has been accepted by the industry concerned. This standard, known as CS93-41, becomes effective for new production on October 18 this year. Printed copies of the standard are obtainable, on request, from the Division of Trade Standards, National Bureau of Standards, Washington, D. C.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 155-174 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description on pages 155-174—or write directly to the manufacturer, mentioning machine as described in May MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 150-151, fill in below the identifying number found at end of each description on pages 150-151—or write directly to the manufacturer, mentioning name of material as described in May MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

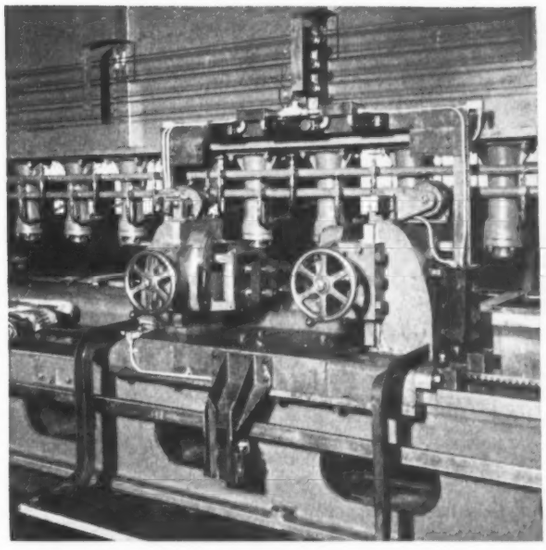


Fig. 1. View of Southwark Steel Plate Planer Carriage, Showing Double Tool-head Equipment

Southwark 40-Foot Steel Plate Planer

To meet the demand for equipment capable of increasing production in the fabrication of steel plates in shipyards and boiler shops, the Baldwin Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa., has recently built a plate planer which will handle steel plates up to 40 feet in length, taking a 1/8-inch cut in a 1 1/2-inch thick plate at a speed of 45 feet per minute. Improvements designed to speed up such operations as planing, straight scarfing, and truing up of plates have been incorporated in this machine, which is shown in Fig. 2.

One or more plates—up to a total thickness of 9 1/2 inches—are laid on the bed, and held in place by twenty-seven hydraulic cylinders which exert a total clamping force of 270,000 pounds. Individual control of the clamp cylinders is provided for, but a single valve can be used

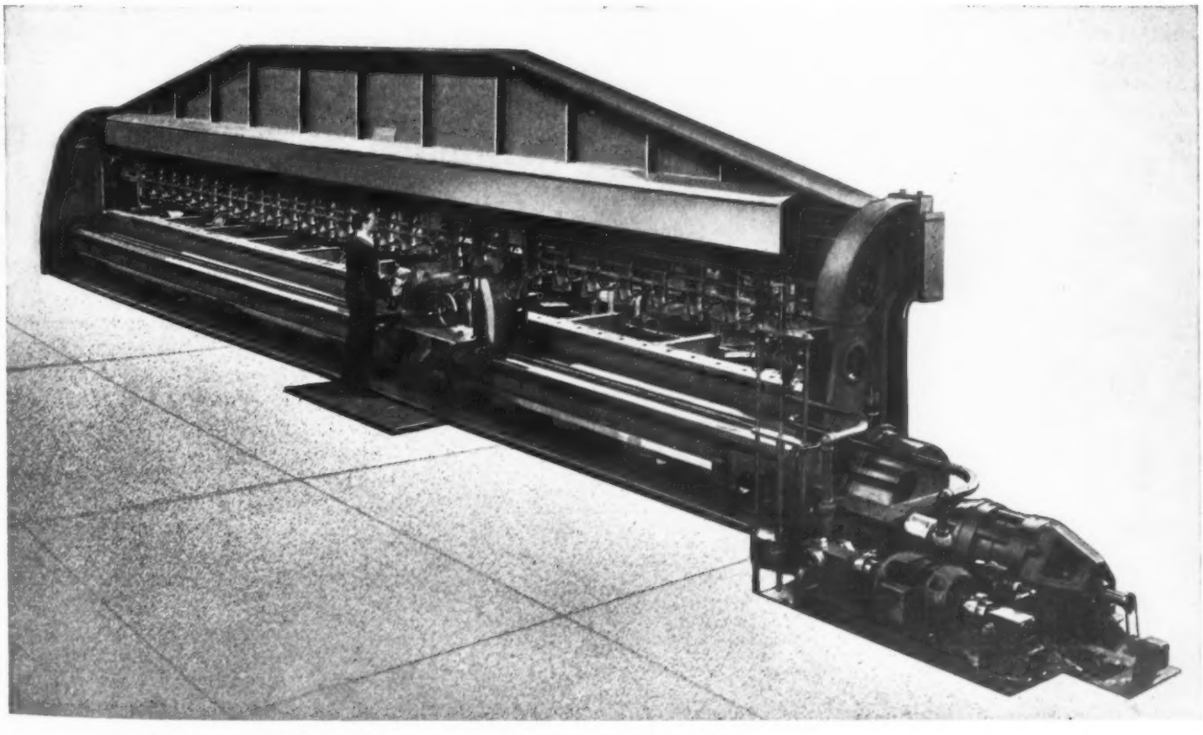
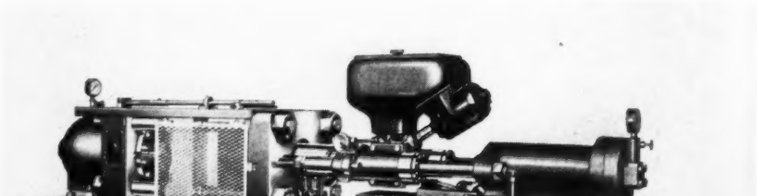


Fig. 2. Southwark Planer with Capacity for Truing up and Planing Plates up to 40 Feet in Length

To obtain additional information on equipment described on this page, see lower part of page 154.

to operate them all simultaneously. Speed and accuracy have been increased by double tooling, which permits automatic carriage reverse and allows the operator to devote all his attention to adjusting or controlling the cut. The tool-holders, shown in the close-up view, Fig. 1, are vertically adjusted by push-button control on the carriage, the operator, of course, riding on the carriage in the position shown in Fig. 2 during the operation.

The gears of this machine run in an oil bath, and the bearings supporting the drive screw are fitted with removable bronze liners. Replacement of the carriage nut has been simplified by an arrangement which permits it to be removed without taking the carriage off the bed. A two-pressure hydraulic pump unit provides hydraulic pressure for the clamp cylinders. Once pressure has been built up and the plate firmly clamped, the motor and pump are automatically shut off and the pressure held by a small hydraulic accumulator. 51



Plastic Molding Press Brought out by Hydraulic Press Mfg. Co.

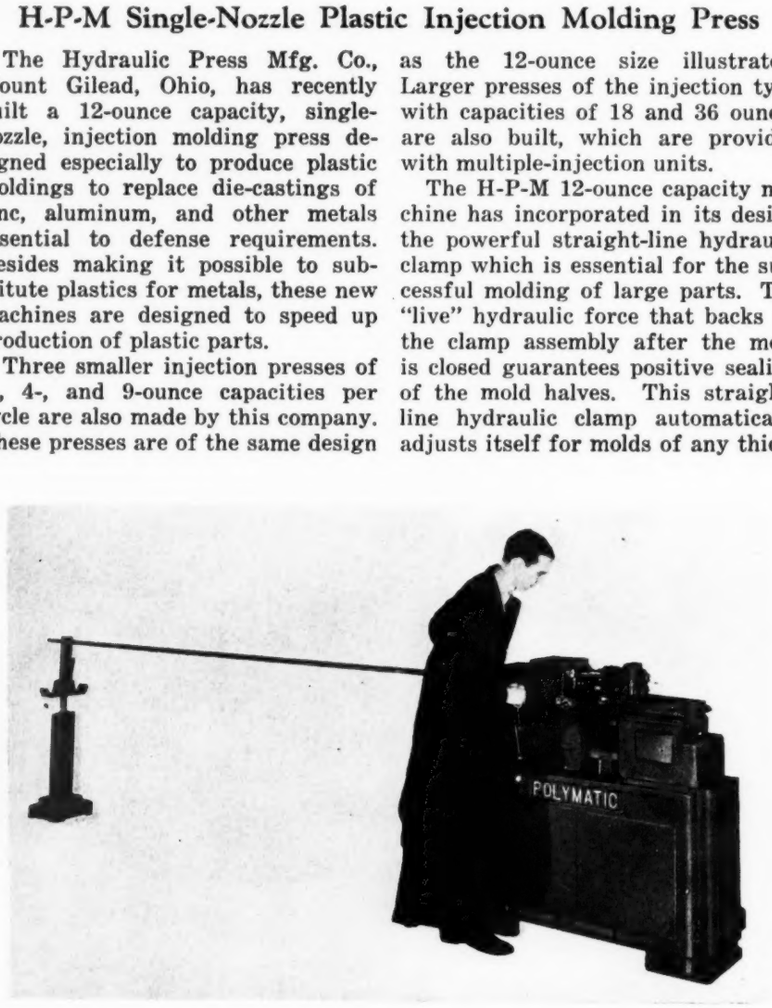
H-P-M Single-Nozzle Plastic Injection Molding Press

The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has recently built a 12-ounce capacity, single-nozzle, injection molding press designed especially to produce plastic moldings to replace die-castings of zinc, aluminum, and other metals essential to defense requirements. Besides making it possible to substitute plastics for metals, these new machines are designed to speed up production of plastic parts.

Three smaller injection presses of 2-, 4-, and 9-ounce capacities per cycle are also made by this company. These presses are of the same design as the 12-ounce size illustrated. Larger presses of the injection type with capacities of 18 and 36 ounces are also built, which are provided with multiple-injection units.

The H-P-M 12-ounce capacity machine has incorporated in its design the powerful straight-line hydraulic clamp which is essential for the successful molding of large parts. The "live" hydraulic force that backs up the clamp assembly after the mold is closed guarantees positive sealing of the mold halves. This straight-line hydraulic clamp automatically adjusts itself for molds of any thickness, thus keeping the die set-up time to a minimum. The circulating fluid heating system assures uniform heating of the plastic material, and thus eliminates flow marks and discoloration in the finished product.

The basic specifications of the 12-ounce capacity molding press are: Clamp pressure, 200 tons; maximum mold size, 16 1/2 by 24 inches; minimum shut height of mold, 6 inches; maximum opening between platens (open position), 18 inches; maximum stroke of mold-carrier platen, 12 inches; maximum weight of material injected at one cycle, 12 ounces; and pressure per square inch on material in the injection chamber, 30,000 pounds. 52



"Polymatic" Screw Machine Brought out by the Unit Machinery Co.

"Polymatic" High-Speed Screw Machine

A "Polymatic" wire forming and cutting-off screw machine of new design has been brought out by the Unit Machinery Co., Rockford, Ill. This completely self-contained unit, known as No. 11, is readily adapted to a variety of simple forming and cutting-off operations on parts of the general type found in typewriters and other precision made products.

The spindle and mounting have been especially designed for smooth operation on precision work at high spindle speeds. The highest speeds are adapted for machining very small wire sizes and free-cutting materials. The wide range of speeds provided meets the requirements for cutting a variety of materials, such as stainless steel, tool steel, brass, and compositions. The driving motor, coolant pump and tank, electrical

To obtain additional information on equipment described on this page, see lower part of page 154.

equipment, and spare change-gears are contained within the base.

The tool-slide can be equipped for any end-machining operation, such as drilling, knurling, or box-turning. Adjustable stops control the forward and backward traverse, thus assuring accurate duplication of work. A pick-up slide can be built into the machine in place of the plain tool-slide. This pick-up slide has a collet controlled by an adjustable cam. The work is held by the collet chuck during the entire operation, preventing breakage of the piece before the cut is completed and thus eliminating burred ends. The collet releases the work as the slide advances to the chucking position, causing the completed part to be pushed into the hollow pick-up spindle. From this spindle the part is discharged into a container at the end of the machine.

The amount of stock feed is variable in a wide range by positioning the driver pin in the constant-stroke feed arm. This mechanism, as well as all other high-speed parts, is lubricated by continuously circulated and filtered oil. The hole through the largest feeding finger is 3/8 inch, and the hole through the spindle is 5/8 inch in diameter. The longest single movement of the stock feed mechanism is 1 3/4 inches, and the maximum distance from the face of the pick-up spindle to the face of the chuck is 3 1/4 inches.

The machine is driven by a 2- to 3-H.P. motor, operating at a speed of 1800 R.P.M. Fourteen changes of spindle speed through pick-off gears cover a range of from 1570 to 7660 R.P.M. The production rate for one piece per cam cycle ranges from 0.8 to 24.2 seconds. The machine is approximately 50 inches in length, and requires a space 170 inches long with a stock support for 12-foot bars. The width is 18 inches, and the weight about 1630 pounds. 53

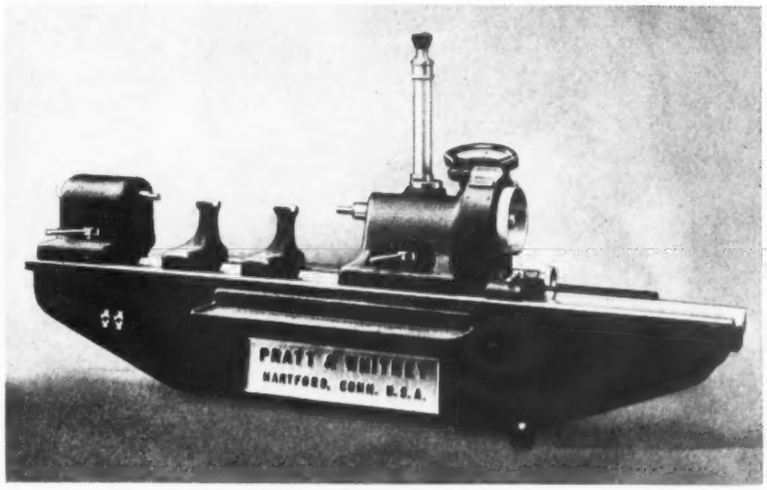


Fig. 1. Pratt & Whitney Standard Measuring Machine for Checking Accuracy of Tools and Gages

Pratt & Whitney Measuring Machine, Lead Tester, and Electrolimit Comparator

Precision measuring and testing equipment recently brought out by the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., is shown in Figs. 1, 2, and 3. The latest model standard measuring machine, Fig. 1, like preceding models, provides a means for checking the accuracy of gages, tools, parts, etc., employed in production work. It reads directly to 0.00001 inch, and is designed to eliminate errors commonly attributed to the "human" element.

This standard measuring machine consists essentially of a master bar, a dividing screw, and a means of controlling the measuring pressure, all mounted on a rigid bed. The master bar is graduated at each inch interval to provide for permanently accurate settings. The graduations are extremely fine hair-lines, visible only through a microscope. The measuring head includes a microscope with two hair-line graduations for use in setting the instrument to match the hair-line on the master bar, and a precision dividing screw which sub-divides one inch. The measuring pressure is controlled by the electrolimit pressure tailstock.

The new lead tester, Fig. 2, is designed to provide greater accuracy, speed, range, and flexibility in checking thread leads. It is exceptionally heavy, occupies a bench space of 37 by 17 inches, and is 15 inches high. It will handle parts up to 4 3/4 inches in diameter, which have a thread length of 4 inches and an over-all length of 8 inches. The measuring head is identical with the one used on the measuring machine shown in Fig. 1, except that the microscope is omitted. It will read accurately to within 0.000025 inch.

Taper threads as well as straight threads can be checked by correctly positioning the swivel work-supporting table. This lead tester belongs in the class of basic measuring equipment, and is a direct reading instrument, not a comparator. The regular equipment includes 4-, 3-, 2-, and 1-inch Hoke precision gage-blocks and a set of seven ball points for gaging threads ranging from 4 to 80 threads per inch.

The electrolimit universal internal comparator, Fig. 3, is designed to meet the demand for an instrument that will measure internal dimensions over a wide range of sizes quickly and accurately. It will reveal out-of-round, taper, and bell-mouthed conditions. This new comparator is

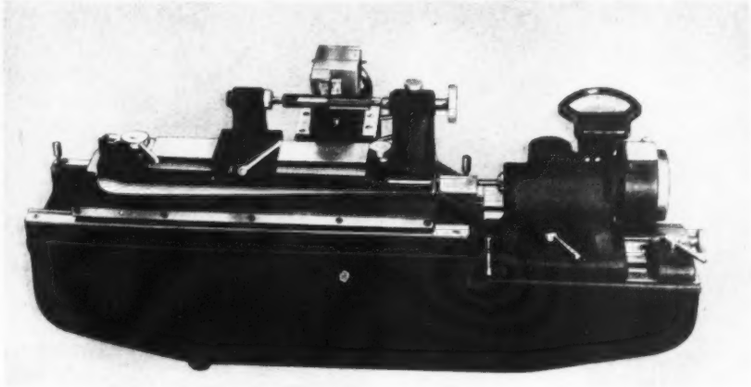
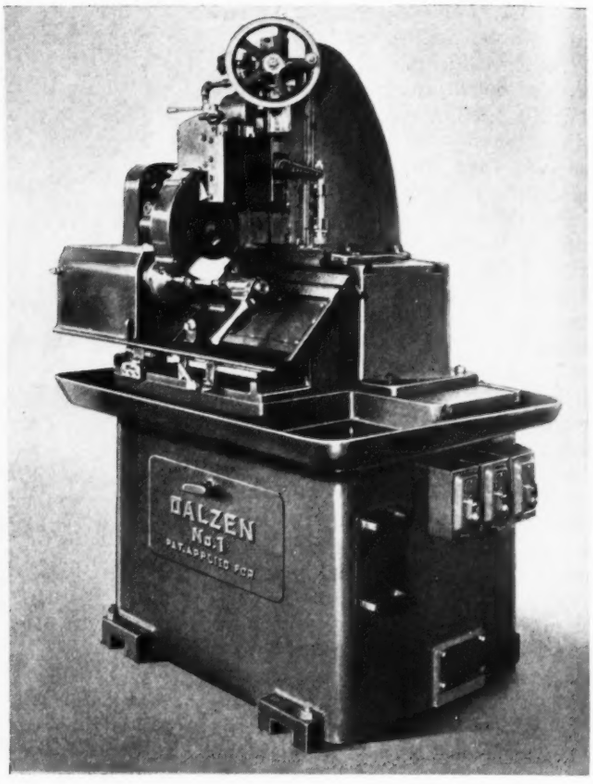


Fig. 2. P&W Lead Tester Designed for Checking Thread Leads

To obtain additional information on equipment described on this page, see lower part of page 154.

Fig. 3. Electrolimit Universal Internal Comparator Equipped for Checking Cylindrical Ring Gage



Vertical Thread Grinder of New Design Developed by the Dalzen Tool & Mfg. Co.

adapted for checking ring gages and similar parts. By taking ordinary precautions with regard to cleanliness of work, temperature, and operating technique, it can be read within an accuracy of 0.00002 inch. The range of sizes covered is from 1/2 inch to 10 inches in diameter, and the floor space occupied, 18 by 20 inches, in addition to the 13 1/2-inch circular space required for the indicator stand. It operates from any 110- to 115-volt, 60-cycle, alternating-current source having a reasonably constant voltage. 54

Westinghouse Alternating-Current Tachometer

To eliminate some of the unsatisfactory features of direct-current tachometers, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed an alternating-current tachometer having no brushes or commutator in the non-sparking generator unit. The alternating-current voltage generated is rectified and indicated in terms of rotational or linear speeds. As a matter of fact, the indicating instrument can be calibrated not only in revolutions per minute and feet per minute, but also in other units per minute. 55

Dalzen Thread Grinder

A vertical thread grinder has recently been developed by the Dalzen Tool & Mfg. Co., 511 Leib St., Detroit, Mich., which represents a marked departure from thread grinders of conventional design. Instead of approaching the work from the side, the grinding wheel moves downward to the work. In this position, the head is directly over its supporting base, and is thus maintained in equilibrium, a condition which facilitates holding the work accurately to size. With this arrangement, the pressure on the feed-screw from the weight of the head is always exerted in a downward direction. The upright position of the new grinder conserves space, the floor area required being only 38 by 48 inches.

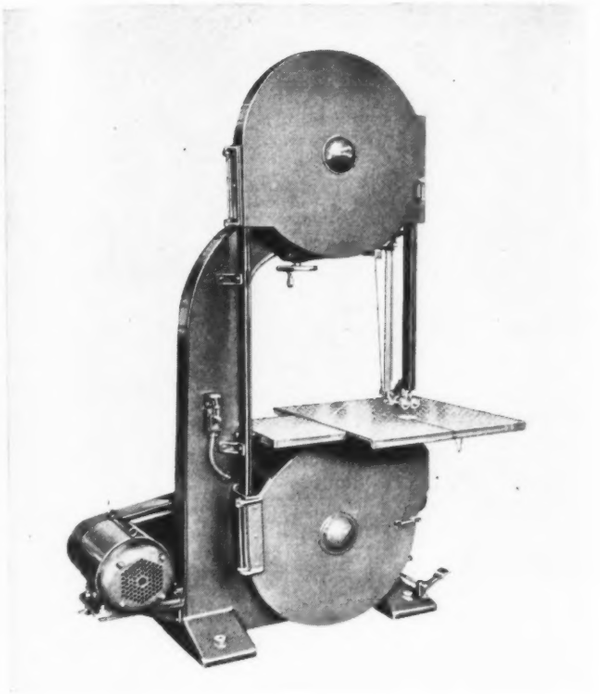
The machine has a capacity for work 6 inches in diameter, and can produce right- or left-hand threads 10 inches in length on any portion of a shaft 18 inches long with the same lead-screw. The head pivots, and can be set accurately to a maximum angle of 25 degrees either side of the center to accommodate right- or left-hand threads of any standard or special forms. A master cam arrangement, with an adjustable fulcrum block and pick-off gears, provides means for grinding variable relief on taps. 56

Band Saw for Cutting Magnesium Blocks 30 Inches Thick

A 36-inch band saw with V-belt drive has been built by the Tannewitz Works, Grand Rapids, Mich., for sawing magnesium blocks 30 inches thick. To accommodate work of this thickness, provision is made for raising the guide to a height of more than 36 inches above the table. Similar machines, all built with special welded frames, are available in any capacity up to those carrying 52-inch wheels for the saw blades. The machine illustrated is designed for cutting various aluminum alloys and pure magnesium, the motor and multiple V-belt drive (with the motor mounted on a bracket at the side) providing suitable saw-blade travel for the specific material handled.

Another band saw recently brought out by this company is a "Di-Saw" with 30-inch throat, 30 inches being

To obtain additional information on equipment described on this page, see lower part of page 154.



Tannewitz Band Saw for Cutting Magnesium Blocks 30 Inches Thick

Fig. 1. Super-duty Knife-grinder Brought out by Samuel C. Rogers & Co.

the distance between the column and the saw blade. Although this exceeds by 6 inches the standard Tannewitz Di-Saw, it is the smallest of several machines of this type available for special work. Tannewitz Di-Saws having 36- to 48-inch throat capacities can be supplied. 57

Rogers Knife-Grinding Machines

Samuel C. Rogers & Co., 185 Dutton Ave., Buffalo, N. Y., has recently brought out two knife-grinding machines, one for grinding straight-edge knives, and the other for grinding circular or disk type knives. The new Type NT super-duty knife-grinder, shown in Fig. 1, is designed to take heavy cuts on straight-edge knives where close limits of accuracy and fine finish under high production rates are required. The extra heavy-duty base is cast as a single unit, and is heavily braced with cross-girders. The ways are automatically lubricated by a special power-driven oil-pump. The base supports the table and knife-bar on wide-surface vee and flat ways designed to take up wear automatically. The standard table and knife-bar speed is 28 feet per minute, but higher speeds can be provided if required. The table and knife-bar drive is by means of a 1 3/4-inch steel rack and hardened steel pinion from the transmission unit.

The transmission is equipped with a double-disk clutch-gear reversing unit. This type of clutch insures smooth positive traverse and shifting of the knife-bar carriage without vibration. The cross-feed of the grinding head, either hand or automatic, can be adjusted to suit requirements. A 5-H.P., splash-proof motor drives the grinding head. The grinding head of the motor-driven machine is equipped with combination radial and thrust ball bearings.

Fig. 2. Rogers Grinder for Sharpening Rotary Knives

The knife-bar is of extra heavy design, and has two work surfaces, one for shear and other heavy blades, and the other for thin blades. The bar can be adjusted for grinding any angle — away from or toward the knife edge. This grinder is also built with special platens for sizing light armor plate 1 inch thick, 36 inches wide, and 100 inches long.

The circular-knife grinder, Fig. 2, is adapted for sharpening circular or rotary knives from 2 to 20 inches in diameter. This machine—the CC-33—is built for continuous operation. One of the new features is the adjustable grinding head, mounted vertically on a heavy slide, which is gibbed to permit taking up wear. The grinding head has a vertical adjustment of 3 inches.

A heavy work-spindle is provided, which permits the use of a cup or straight grinding wheel 6 inches in diameter by 2 inches thick. Another feature is an attachment for mounting work between centers, which adapts the machine for a wide variety of grinding operations.

Adjustments to meet all requirements of circular-knife grinding are

To obtain additional information on equipment described on this page, see lower part of page 154.

provided by three slides with handwheel controls. Each slide is fitted with gibs that can be adjusted to compensate for wear. The swivel base is graduated to insure correct angular settings. The same angle is maintained without making any changes to compensate for grinding wheel wear or change in the size of the knives being ground. The weight of the grinder is 1000 pounds. 58

Vernon Vertical Mills Equipped for Jig Boring and Profiling

With the aid of attachments for profile tracing and precision measurement, the Vernon vertical mill recently placed on the market by the Machinery Mfg. Co., 1915 E. 51st St., Vernon, Los Angeles, Calif., can be readily converted into either a small jig borer or a profiler for duplicating a wide variety of cavity mold work, in addition to performing its regular function as a milling machine.

The profiling attachment is designed for duplicating die-casting dies, plastic molds, and small drop-forging and forming dies, and is also adapted for the production of irregular shaped small parts. It can be quickly applied to the vertical mill by engaging the jaws of a multi-jaw coupling, thus joining the pinion shafts of the profile attachment and the machine.

To complete the assembly, the machine hand-lever, previously removed, is attached to the right-hand side of the profile attachment, as shown in Fig. 1, for actuating both the profile attachment quill and the machine quill, which move up and down as a unit, a handwheel providing a fine vertical feed. A micrometer dial, graduated in thousandths of an inch, provides an accurate means of controlling the depth of cut. The distance between the centers of the profile attachment spindle and the machine spindle is 6 inches, and the former has a vertical adjustment of 1 inch, independently of the latter.

To convert the Vernon vertical mill into a small precision jig borer, a standard set of measuring fixtures consisting of two dial indicators, together with seven measuring rods ranging from 1 inch to 4 inches in length, as well as troughs for attaching the equipment to the machine are used, as shown in Fig. 2.

The vertical mill has a fine feed controlled by means of a handwheel, and a rapid 1-to-1 traverse with hand-lever. The spindle is mounted in preloaded precision ball bearings, and the cross and longitudinal screws are also mounted in ball bearings. Adjustable bevel dials, graduated in thousandths of an inch, are provided for all feeds. 59

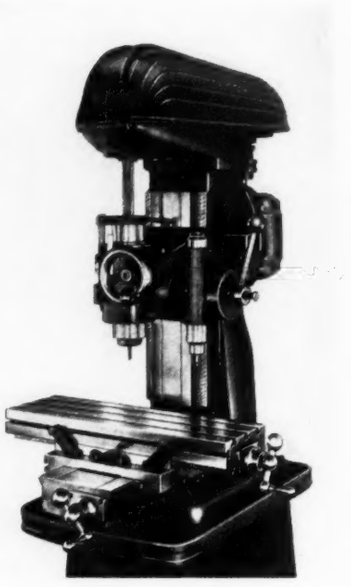


Fig. 1. Vernon Vertical Mill Equipped for Profiling

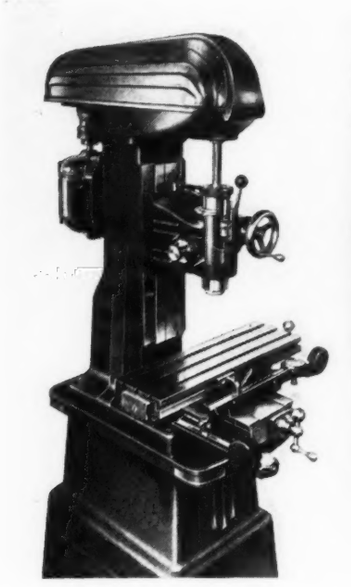
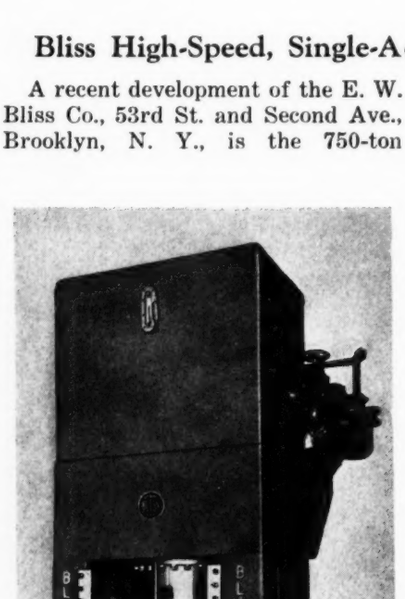


Fig. 2. Vernon Vertical Mill Equipped for Jig Boring

Bliss High-Speed, Single-Action Hydro-Dynamic Press

A recent development of the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y., is the 750-ton hydro-dynamic press here illustrated. This press has many unusual operating features, including an intermediate pressing cylinder which gives a higher speed at low pressures (under 350 tons) and yet has a maximum pressing capacity of 750 tons at the normal pressing speed. This feature is of especial value in deep drawing, where the press operates at high speed throughout the drawing portion of the stroke and automatically changes over to the normal pressing speed to finish the work with a coining operation.



Bliss 750-ton, High-speed, Single-action, Hydro-dynamic Press

The following press speeds were obtained with the regular pumping unit: 665 inches per minute quick advance; 56 inches per minute pressing speed for pressures up to 350 tons; 27 inches per minute for pressures from 350 to 750 tons; and 720 inches per minute return speed.

The press is equipped with the Bliss all-electric control for both production operation and die setting. Speed changes and the reversal of the press slide can be controlled either by position controls or pressure limits in the hydraulic system. The electric control devices are mounted in the side housing of the press, where they are concealed and protected. An adjustable bar knockout is furnished in the slide. 60

To obtain additional information on equipment described on this page, see lower part of page 154.

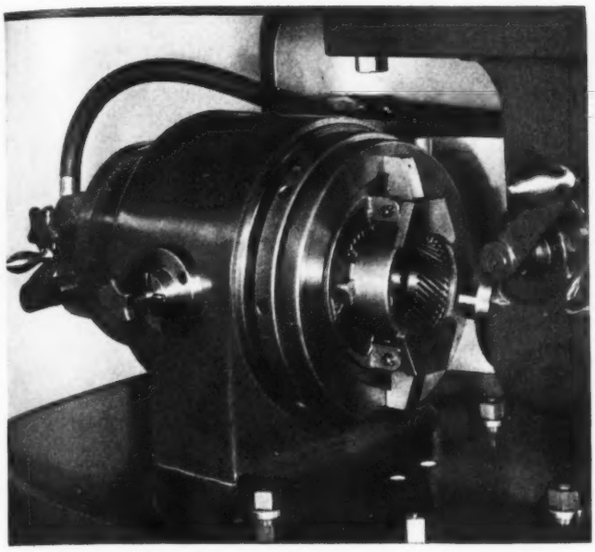


Fig. 1. View of Michigan Gear Shaver with Work in Place

Horizontal Disk Grinder Built by Gardner Machine Co.

Michigan Crossed-Axis Gear Shaver for Finishing Internal Gears

A new type of crossed-axis gear shaver for finishing the teeth of internal gears has been added to the line of gear finishing machines made by the Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich. This machine, as shown in Fig. 2, closely resembles the Series 860-B rotary gear finishers for spur and helical gears. The new shaver, known as Model 860-B-1, finishes internal gears by means of a combination of work rotation, cutter reciprocation, and vertical feed for the work.

In contrast to the external gear finishers, the new machine provides for mounting the cutter on the head of the machine, while the work is located in a special driving fixture on the knee. This arrangement permits lateral reciprocation of the cutter through the drive to the head while the work is being rotated and fed into or toward the cutter.

In Fig. 1 is shown a close-up view of the work-head with an internal gear in place. The cutter has been removed from the spindle to the right, in order to illustrate the installation more clearly. This work-head is driven by a V-belt from the machine base. Special provision is made for locating the work accurately in the combination chuck and clamp prior to the shaving operation.

The coolant is carried to the work through the spindle of the hollow locator. Six diagonally drilled holes in the face of the locator direct the coolant against the teeth of the gear to be shaved when the locator is in both the retracted and operating positions. 61

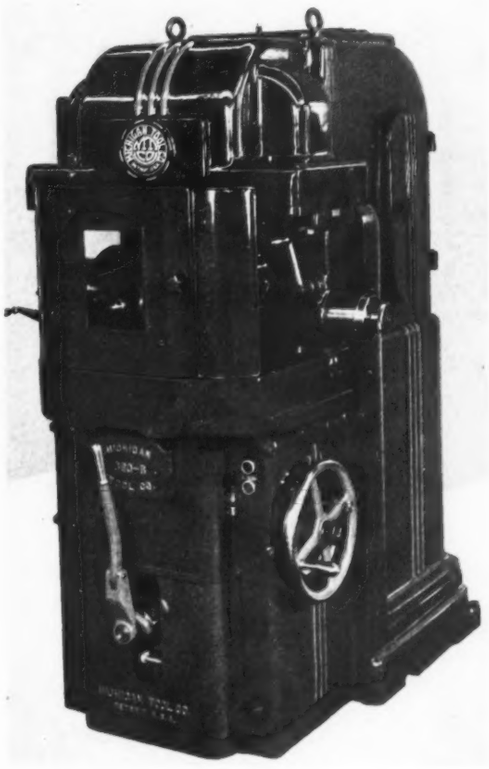


Fig. 2. Michigan Internal Gear Shaver

Gardner Horizontal Disk Grinder

A new horizontal disk grinder (No. 186), which is available with a steel disk wheel 30 or 36 inches in diameter, has been placed on the market by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. This machine is particularly designed to meet the requirements of those who prefer V-belt motor-driven equipment, and who wish to use standard motors. Like previous machines of this company's manufacture, it is adaptable to the numerous operations requiring simply the production of a flat surface that need not have a definite relation or position with respect to any other portion of the part.

The new machine is larger and heavier than previous models, and embodies two important features — a louvre type removable guard ring, which facilitates the removal of grinding dust and grit; and a swinging bar type dresser. When equipped with a hand-operated swinging work-table, the machine can be used to grind two surfaces on one casting in accurate relation with each other.

Work-holders or special attachments can be secured to the guard ring, which is fastened to the top of the machine base. Either wet or dry grinding can be performed, a welded outside settling tank, complete with motor-driven

To obtain additional information on equipment described on this page, see lower part of page 154.

pump, being furnished for use in wet grinding.

The spindle speed with the 30-inch disk is 720 R.P.M., and with the 36-inch disk, 585 R.P.M. The rated capacity or load on the thrust bearing is 10,400 pounds. A motor of 5 to 15 H.P., with a speed of 1800 R.P.M., is recommended. When equipped with a 7 1/2-H.P. motor, the shipping weight is approximately 3500 pounds. 62

Landis "Race-A-Way" Grinder for Small Ball Races

A machine designed for the production grinding of raceways for small ball bearings has been brought out recently by the Landis Tool Co., Waynesboro, Pa. This machine, designated the No. 1 Race-A-Way grinder, is intended for use in grinding small races up to the No. 204 size, including double-row races.

Many of the design details of this grinder are similar to those incorporated in the No. 2 Race-A-Way grinder described in October, 1938, MACHINERY. The adaptability of the No. 1 machine for handling very small races, its unusual automatic cycle, which is based on the compensating type of Landis-Solex sizing device, and its 50,000 R.P.M. grinding wheel spindle are outstanding features.

The entire grinding cycle is automatic, it only being necessary for the operator to load the work into the machine and depress the cycle starting button. The machine is so arranged that the coolant flow can be automatically stopped during the finishing operation of the cut and resumed as the wheel backs away from the work and stops at the end of the cycle. If desired, however, the flow of coolant can be continued to the end of the cycle, when it automatically stops. The Landis diaphragm chuck recommended for this work is available in two sizes. The first is suitable for races having an outside diameter of 3/8 to 1 3/16 inches, while the second will take races from 1 3/16 to 2 inches in diameter.

The weight of the machine, including electrical equipment, is 3500 pounds. The floor space required is 35 by 41 inches. Four electric motors of the constant-speed type are employed, the work-drive motor being 1/4 H.P., 1750 R.P.M.; the wheel-drive motor, 2 H.P., 3600 R.P.M.; the oscillating drive motor 1/3 H.P.; and the pump-drive motor, 1 H.P., 1200 R.P.M. 63

Gould & Eberhardt Gear-Hobber for Rapid Production of Turbine Gears

A large gear-hobbing machine designed to generate high-speed single- and double-helical marine turbine reduction gears with extreme accuracy on a production basis has been built by Gould & Eberhardt, Newark (Irvington), N. J. This machine—the 120H universal gear-hobber—will hob gears up to 120 inches in diameter, of 2 1/2 diametral pitch, with a face width of 48 inches and a helix angle of 45 degrees. Gears with small helix angles can be hobbed in sizes up to 160 inches in diameter. Meehanite castings are used for the principal members of this machine.

The machine has two cutter-heads so located that both right- and left-hand portions of double helical gears can be cut simultaneously. Either cutter-head can be disconnected and the machine operated as a single-head machine. The main gear mechanism and driving motors are located away from the machine proper, and all driving shafts are journaled outside of the machine, so that any heat generated will not be transmitted to the other units and thus affect their alignment.

The backlash between the indexing worm and the gear driving the work-table is controlled by the application of a new patented drive designated "Dual-Lead Worm-Gearing." The worm has a thread that varies in thickness from one end to the other. The mating worm-gear is correspondingly modified, so that the proper tooth rolling action is at-

Fig. 1. Landis No. 1 Race-A-Way Grinder

Fig. 2. Typical Set-up Employed on Landis Grinder

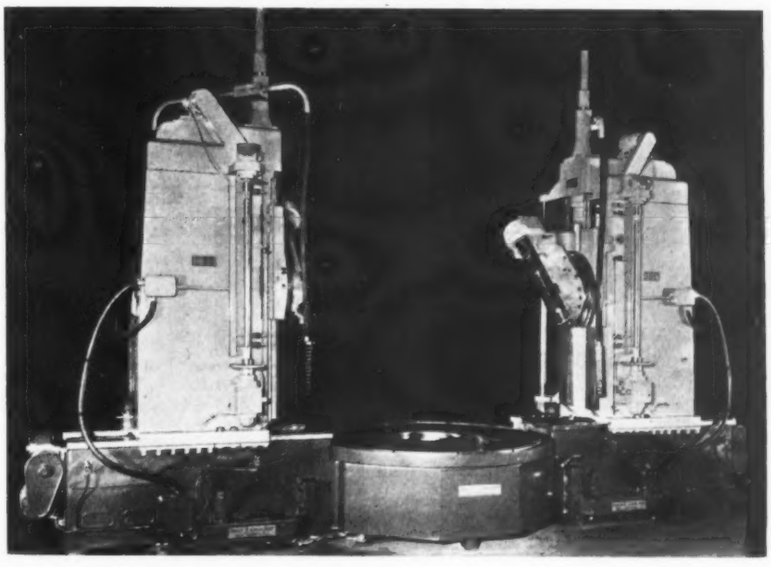
To obtain additional information on equipment described on this page, see lower part of page 154.

tained in either direction of rotation. By axially adjusting this dual-lead worm, the backlash is controlled without disturbing the center distance or uniform driving motion.

Accuracy of the final index drive is maintained by employing two sets of index-worms and gears, one set of coarse pitch being used for roughing and also for truing the gear blanks for concentricity, while the other set of fine pitch is used exclusively for finishing.

A complete duplicate set of lubricating motors, pumps, and filters is supplied as a precaution against failure of the lubricating systems. Eleven motors are used to operate the machine, six direct- and five alternating-current motors being employed. The selection of direct-current motors for the main drive, lubricating, and coolant functions makes possible the automatic switch-over to a standby storage battery in case of power supply interruption. A horn signal gives warning when the main-drive motor is overloaded, so that the machine can be slowed down without stopping the operation.

Accuracy tests made on one of these machines after erection in a customer's plant showed the alignment of the stanchions to be accurate within 0.00025 inch in 4 feet. The accumulated error in lead was within 0.001 inch in 4 feet. The average periodic error corresponding to one revolution of the index-worm did not exceed plus or minus 0.00005 inch on a gear 120 inches in diameter, and the accumulated pitch error was less than 0.002 inch on the same size gear.



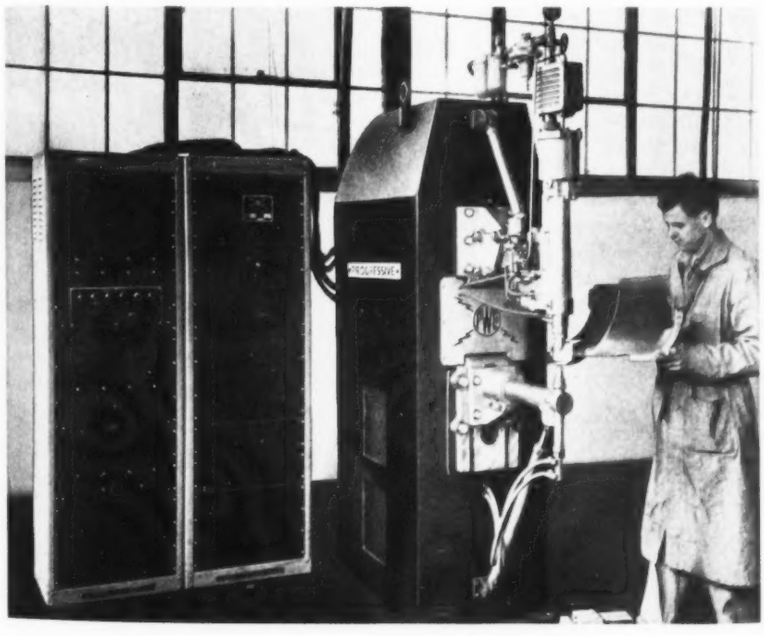
Gould & Eberhardt Universal Gear-hobbing Machine Designed to Generate High-speed Single- and Double-helical Turbine Reduction Gears

Gears produced by double cutting have a fine surface finish and run quietly without lapping or corrective processes. The time saved, as compared with single-cutting machines, is almost 50 per cent. 64

Equipment for Rapid-Production Welding of Aluminum-Alloy Sheets in Aircraft Plants

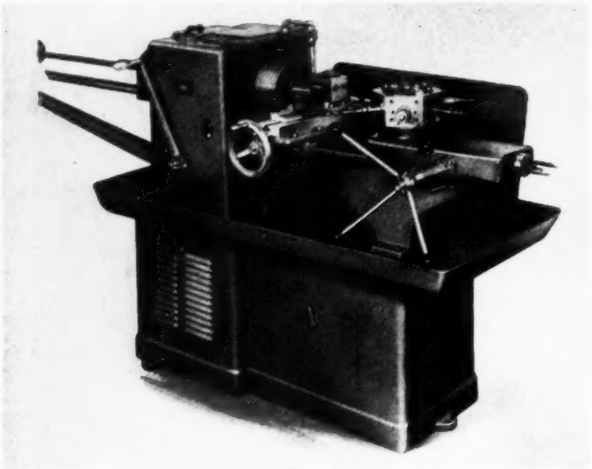
A high-speed production process for spot-welding aluminum-alloy sheets for aircraft, which involves an entirely new principle of operation, has been developed by the Progressive Welder Co., 3050 E. Outer Drive, Detroit, Mich. This process is said to produce welds in aluminum alloy with a uniformity equal to that obtainable in the production welding of steel. It involves no costly or complicated equipment, and does not require any special skill on the part of the operator. The welding speeds correspond with those commonly used in welding sheet steel, and are limited only by the speeds at which the work can be moved between welds.

In addition to uniformity, welds made with this process appear to be entirely free from cracks and blowholes. The welding equipment employed is simple to operate, only two adjustments being required in handling all types of welding operations within the capacity of the machine. The principle of operation is based on the use of all three phases of three-phase alternating current, the proper wave form for the weld being developed to permit accurate control of the welding current. The flexibility of the equipment permits welding aluminum sections totaling 1/4 inch in thickness down to the thinnest weldable sheet on the same machine. It is possible, for instance, to spot-weld seven pieces of 0.032-inch section 24 S.T. aluminum sheet with a 150-kilovolt ampere, three-phase welder. 65



Progressive Spot-welder for Use in Aircraft Plants

To obtain additional information on equipment described on this page, see lower part of page 154.



Turret-equipped "Rapiduction" Machine Built by Oster Mfg. Co.

"Tocco Junior" Unit Designed for Heat-treating Small Parts

Oster "Rapiduction" Machine Equipped with Turret

The Oster Mfg. Co., 2073 E. 61st St., Cleveland, Ohio, has brought out a turret for its No. 601 "Rapiduction" machine which was placed on the market about six months ago. Originally equipped with a cross-slide and plain saddle only, the machine can now be furnished with a six-station turret. Thus equipped, it is adapted for use as a simple, plain-head, hand-operated screw machine which does not require a highly skilled operator.

The turret is hand-operated and hand-indexed, saddle stops being automatically synchronized with the revolution of the turret. Each turret face has six tapped holes for mounting tool-holders of the sizes in common use. Either a lever-feed or a screw-feed cross-slide can be furnished, as desired. Both worm and direct drives to the spindle are now available, with power furnished by a two-speed motor. Reverse or electric braking control can be provided.

Multiple V-belts from the motor to the worm-shaft or spindle through quick-change sheaves give spindle speeds from 140 to 1000 R.P.M. in the worm-driven machine, and from 900 to 3000 in the direct-drive model. The spindle nose is a No. 6-A1 American standard flange type.

The round-bar capacity of the automatic chuck is 1 1/2 inches, while the swing is 14 inches over the bed, and 6 1/2 inches over the cross-slide. The machine occupies a floor space of 33 by 70 inches without the bar-feed extension, which requires a space 94 inches beyond the pan. The weight is 1450 pounds. 66

"Tocco" Utility Unit for Heat-Treating Small Parts

A streamline "Tocco Junior" machine of 20-kilowatt output capacity, especially designed for heat-treating small parts, has just been brought out by the Ohio Crankshaft Co., 6600 Clement Ave., Cleveland, Ohio. This unit, designed to sell at a lower price than the larger machines, is offered in two models—one for applications not requiring quenching, such as annealing, brazing, soldering, and heating for forming and forging; and the other for localized Tocco-hardening.

In the hardening machine, a transformer housing and work-pan have been added to the otherwise flat-topped basic 20-kilowatt unit. The rotatable transformer panel to which the inductor block is attached is similar to that of the larger "Tocco Junior" units, as are also the quench and cooling water valves, condensers, tapped bosses for holding fixtures in alignment with the inductor, etc.

Both the 20-kilowatt Junior models use the same high-frequency motor-generator sets supplying 9600 cycles of high-frequency current at 220 volts, and both units have all the required control devices. For Tocco-hardening, the 20-kilowatt model is equipped with preset full automatic controls and a suitable hardening fixture. 67

"Weld-Master" Alternating-Current Electric Arc Welder

Simplified welding is claimed as the outstanding feature of an alternating-current electric arc welder just placed on the market by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. A reactance winding on a separate core, in addition to the transformer, acts as a stabilizer, making it easy to strike and hold an arc. As the distance between the end of the welding rod varies, the reactance winding causes the voltage to vary proportionately, so that the arc is kept smooth.

Fifteen different welding heats between 20 and 175 amperes at two voltages—45 and 70 volts—provide accurate heat and penetration control for each job and different parts of the same job. Penetration may

"Weld-Master" Arc Welder, Made by Ideal Commutator Dresser Co.

To obtain additional information on equipment described on this page, see lower part of page 154.

be 1/4 inch or more if desired. The standard welder is for 230-volt, 60-cycle operation. It is recommended that 1/16- to 5/32-inch welding rod be used. The primary current is 1.75 amperes at no load, and 52 amperes at full load. The over-all dimensions of the welder are 17 by 15 by 26 inches high, and the weight is 190 pounds. 68

Carboloy High-Capacity Tool Grinder

A new and larger carbide tool grinder of the double-end type, designed to permit two operators to grind tools simultaneously, has been added to the line of machines built by the Carboloy Company, Inc., 11147 E. 8 Mile Blvd., Detroit, Mich. This 14-inch machine is the largest in the Carboloy line of tool grinders. Its high capacity makes it particularly suitable for use in plants where a large number of carbide tools are ground daily; where large amounts of carbide must be removed from the tool or work; and where heavy-duty cemented-carbide turning, boring, facing, or planer tools, as well as smaller tools are to be conditioned.

The grinder uses two 14-inch disk type wheels—one at each end. Each end also has its individually adjustable tool-rest table. This arrangement adapts the grinder for rough- and finish-grinding or for rough- and semi finishing-grinding before lapping. The tool-rest tables are made exceptionally large—9 by 22 inches—to facilitate the handling of large tools. These tables are individually adjustable by means of crank-handles, graduations being provided on the side of the table to assure accurate setting. The tool-rest tables can also be adjusted toward or away from the wheel. The wheel guards move with the table brackets. Suction spouts are provided for connection to individual or centralized exhaust systems. The table is designed to accommodate special fixtures.

Buttons for interlocking, start, stop, and reversing switches are located on the front of the base. The 2-H.P. fan-cooled motor in the base is fully enclosed. Drive belt adjustment to the 1350-R.P.M. spindle is made by positioning the motor hinge plate through a removable cover. The spindle height is 42 inches; the floor space required, 49 by 26 inches; and the weight, about 2000 pounds. 69

Michigan Portable Gear-Checking Recorder

New gear-checking equipment by means of which chart records of involute "form" and "lead" can be obtained from gear-checkers of the indicating type has been developed by the Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich. This recorder, operating on a new electrical principle for gear-recording devices, can be coupled to any Michigan "Sine-Line" lead-checker or involute-checker for gears or hobs by simply making the proper electrical connections. It operates on standard 110-volt alternating current, and can be adapted for use with other makes of checking equipment.

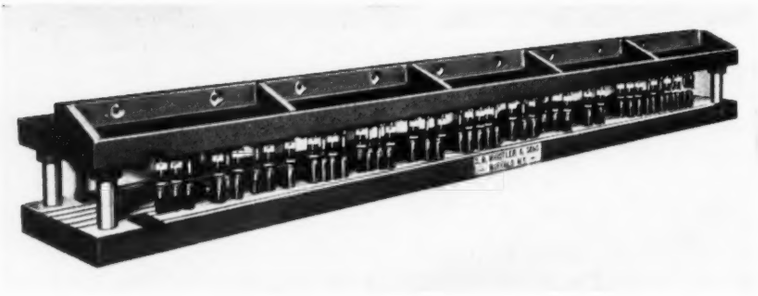
The operation is based on the use of synchronous devices, one located in the recorder and one installed in the gear-checker. Any motion imparted to one of them is automatically and accurately duplicated in the other through electrical connections, the effect being the same as coupling the two units together with a solid shaft. The synchronous device in the gear-checker is connected directly to the sine-bar table, while the device in the recorder is connected to the chart drive.

A second electrical connection between the checker and the recorder actuates the cross-movement of the recording pen in relation to the movement of an indicator mounted on the gear-checker. This indicator replaces the conventional indicator. The movement of the electrical indicator pen on the chart is magnified several times between the indicator and the recorder. Vertical graduations on the recorder represent 0.0001 inch, while horizontally, 1 inch is equal to 4 degrees of rotation of the work-carrying spindle. 70

High-capacity Tool Grinder Brought out by the Carboloy Company

Portable Recorder Developed by the Michigan Tool Co., Applied to Gear-checker

To obtain additional information on equipment described on this page, see lower part of page 154.



Die-shoe with Adjustable Perforating Dies Made by S. B. Whistler & Sons, Inc.

Ten-Foot Die-Shoe with Adjustable Perforating Dies

A die-shoe, 18 inches wide by 120 inches long, for use in a 10-foot power brake utilizing adjustable perforating dies, has been brought out by S. B. Whistler & Sons, Inc., 752-756 Military Road, Buffalo, N. Y. The saving in time and die costs in getting into production, and the additional time saved on the job, are important advantages claimed for this development. The manufacturer for which this die-shoe was built plans to employ this equipment for producing as many as 100 holes per stroke in duralumin sheets used for airplane parts.

In the illustration are shown forty-four Whistler adjustable perforating punch and die units arranged along the front of the shoe only, with room available for at least twice as many more units. These adjustable dies can be quickly arranged with respect to the locations, as well as the sizes and number of perforations. The adjustable dies are available from stock in a wide range of sizes. This equipment is adapted for perforating or gaging operations on either short or long run jobs. 71

G-E Fractional-Horsepower Motor for Machine Tools

A new fractional-horsepower motor built specifically for machine tools and other industrial applications where frequent start-stop service or plugging (quick stopping of motors by reversing the power connections) is necessary and where metal-dust atmospheres are encountered, has been placed on the market by the General Electric Co., Schenectady, N. Y. It is available in 1/4-, 1/3-1/2-, and 3/4-horsepower sizes for operation on three-phase and direct-current systems.

The motor is of totally enclosed construction, which protects it from abrasive metal dust, chips, cutting compounds, and other foreign materials. The stator is especially designed to withstand the repeated stresses of frequent starts and stops

Fractional-horsepower Motor for Machine Tools

as well as of plugging and momentary overloads. Formex, a new G-E heat- and solvent-resistant magnet wire, is used for the windings, which are wedged in the stator slots and firmly anchored. The rotor is of one-piece cast aluminum.

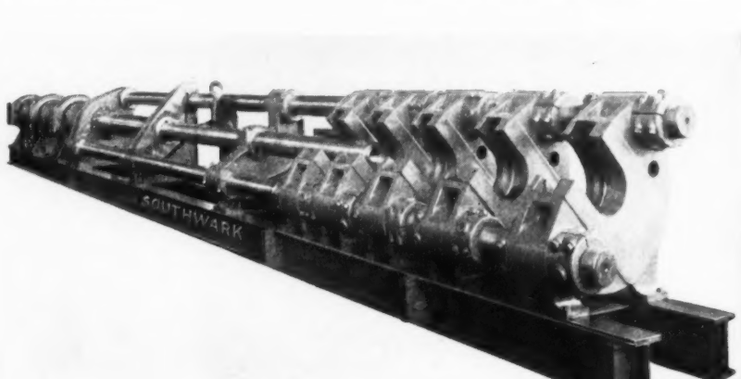
Because of the thrust encountered on the majority of machine tool applications, ball-bearing assemblies are used in the new motor. This allows the motor to be mounted with the shaft at any angle to the horizontal, and the stator can be rotated to any desired position. End-mounted motors can be mounted vertically, as well as horizontally, and can be obtained for flange, flat-face, or rabbet-machine mounting. The mounting dimensions of the malleable cast-iron base are similar to those for motors of comparable frame size previously furnished for machine tool service. 72

Southwark Draw-Bench for Large Shells

A 340-ton horizontal hydraulic draw-bench has been built by the Baldwin Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa., for performing drawing operations on 12-inch to 15-inch shells for naval and coast defense guns. Previous to the drawing operation, the heated billet is pierced on a vertical hydraulic piercing press of approximately 1500 tons capacity.

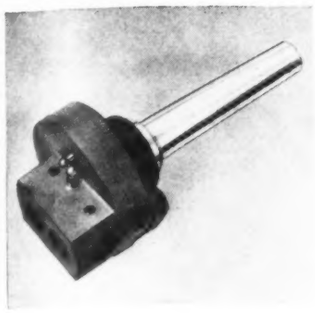
The draw-bench is fitted with five die-holders that can be adjusted horizontally and are designed for quick replacement of the ring dies. The forward end of the hydraulic piston is attached to a cross-head which is guided on the columns, and the water-cooled mandrel holder moves through bronze bushings on a fixed cross-head. The entire unit is mounted on a structural-steel base to insure proper alignment.

The valve and piping arrangement is designed to provide a high drawing speed and a fast return stroke, in order to shorten the time that the hot shell forging remains in contact with the drawing punch. 73

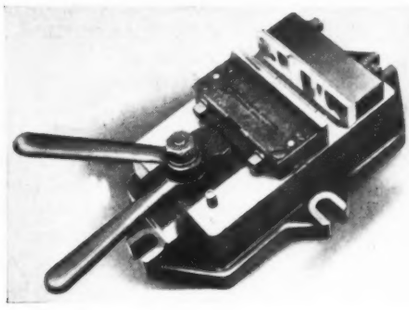


Southwark Draw-bench Designed for Drawing 12- to 15-inch Shells

To obtain additional information on equipment described on this page, see lower part of page 154.



L & M Offset Boring Head



Milling Vise for Small-arms Work

L & M Positive Offset Boring Head

A new offset boring head has been placed on the market by the Pacific Tool & Supply Co., 344 N. Vermont Ave., Los Angeles, Calif. The outstanding feature of this tool, known as the L & M positive offset boring head, is the provision of two spherical hardened buttons to insure accurate measuring of the amount of offset. One button is attached to the stationary part of the head, while the other, which has a flat on one side, is attached to the adjustable part of the head. Accurate settings can be made by taking micrometer readings across these two buttons.

The head has a capacity for boring holes up to 15 inches in diameter. The boring-bar hole size is 1 inch. The outside diameter of the boring head is 4 7/16 inches, and the length, without shank, is 3 11/16 inches. Standard shanks available are B & S Nos. 9, 10, 11, and 12; Morse No. 4; and straight shanks for use on turret lathes. 74

Hartford Quick-Acting Milling Vise

A quick-acting vise designed particularly for use in milling small arms has been placed on the market by the Hartford Special Machinery Co., Hartford, Conn. The lower cam-faced handle of the vise, as shown in the illustration, gives a quick opening or closing action, while the upper eccentric lever handle provides a powerful binding force. When the eccentric binding lever is released, a quarter-turn of the cam-lever opens the movable jaw approximately 7/8 inch, which permits chips to be removed from between the jaws by either brush or air.

The rear or movable jaw is made of a single heat-treated steel drop-forging. The vise is designed to maintain accurate alignment of the jaws, even when a single piece is held at either end. The jaws are interchangeable with those of a No. 2 Brown & Sharpe vise. Slots for 5/8-inch keys are provided at right angles to each other on the base. A swivel-jaw type of vise is available for handling tapered work or for milling two pieces at one time. For the latter purpose, a soft swivel jaw can be obtained which can be milled to provide work seats or rests to hold irregular shaped pieces.

The vise jaws are 5 inches wide by 1 3/16 inches deep, and have a maximum opening, in the plain-jaw type, of 2 5/8 inches. With the jaws removed from the vise, the maximum opening available for clamping is 3 1/2 inches. The swivel-jaw type has a maximum opening of 2 1/4 inches with the jaws in place. The dimensions of the vise are 8 inches wide, 5 inches high, and 13 inches long at the base. 75

Federal Inspection Gages

Two new gages have been brought out by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. The Model 264 P dial indicator gage, shown in Fig. 1, is in effect a modernized type of snap gage, and is made in a wide range of sizes. It is light in weight, being made of Dowmetal, and is much faster and more positive than the older type "feeler" gage. With this snap gage, the inspector can see exactly how the work varies in diameter from the master or specified dimensions, and the accuracy of the measurement does not depend on the skill or "touch" of the inspector.

The gage has an adjustable lower anvil with a rounded lip to facilitate inserting the work, and an upper anvil which operates under an auxiliary spring tension to maintain a uniform pressure on the work. The back-stop, arranged as shown in the illustration, is adjustable to accommodate various diameters.

The Model 1202 B-5 bench type plug gage, shown in Fig. 2, is a mechanical gage having the characteristics of a fixed type plug gage combined with the speed and accuracy of a dial indicator gage. The dial indicator on this particular gage reads to 0.00005 inch, and finer readings of 0.000025 inch can be estimated on the dial.

One of the outstanding advantages of this gage is its ability to make accurate repetitive measurements. The motion of the contact point is transferred directly to the indicator through one solid continuous unit. The sensitive contact point is located underneath the plug, and there are two longitudinal locating points. The locating contacts can be interchanged to suit holes of different sizes. The guiding tip over which the ball-bearing raceway is slipped is also interchangeable. The interchangeable stop-collar surrounding the plug can be adjusted to locate the work accurately for gaging. 76

Fig. 1. Federal Dial Indicator Gage

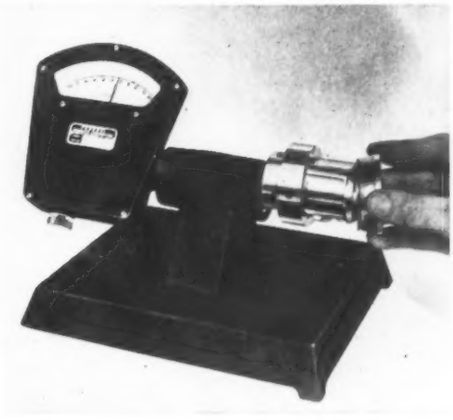


Fig. 2. Federal Bench Type Plug Gage with Dial Indicator

To obtain additional information on equipment described on this page, see lower part of page 154.

Baldor Grinder with Enclosed Guards

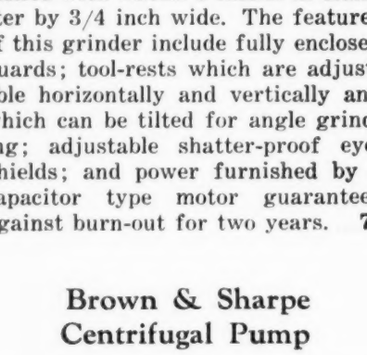
Baldor Grinder

The Baldor Electric Co., 4400 Duncan Ave., St. Louis, Mo., has developed a new 6-inch grinder designated the No. 612. This grinder is rated at 1/3 H.P., 3440 R.P.M., and is furnished with wheels 6 inches in diameter by 3/4 inch wide. The features of this grinder include fully enclosed guards; tool-rests which are adjustable horizontally and vertically and which can be tilted for angle grinding; adjustable shatter-proof eye-shields; and power furnished by a capacitor type motor guaranteed against burn-out for two years. 77

Brown & Sharpe Centrifugal Pump

A motor-driven centrifugal pump has recently been added to the line of pumps made by the Brown & Sharpe Mfg. Co., Providence, R. I. This 206A pump differs from the 206 pump in that it has a base of small diameter which will readily fit into small, narrow tanks or other places where space is limited.

The pump is furnished with a 1/4-H.P. motor, and will handle liquids with viscosities up to 1000 seconds Saybolt Universal. When pumping water at 1725 R.P.M., the discharge varies from 20.5 gallons per minute at 5 feet total head to 8.5 gallons per minute at 11 feet total head. The delivery when handling oil is slightly reduced. 78



Brown & Sharpe Motor-driven Centrifugal Pump

"Hi-Duty" Tapping Machine Made by L. J. Kaufman Mfg. Co.

"Hi-Duty" Tapping Machine

A new No. 10-A "Hi-Duty" tapping machine with Hi-lo gearing is now being made by the L. J. Kaufman Mfg. Co., Manitowoc, Wis. This machine is equipped with a two-spindle head and a semi-automatic magazine fixture. The nuts are fed to the magazines by hand, and are located beneath the taps and ejected automatically. This taper can also be equipped with a revolving index type fixture or any other type normally used for this class of work. The machine has twelve speeds arranged in geometric progression. 79

Rockford LMC Clutch

The Rockford Drilling Machine Division, Borg-Warner Corporation, 310 Catherine St., Rockford, Ill., has recently placed on the market a clutch designed for use with gasoline or other motors, and for various applications requiring the transmission of power up to 6 H.P. The new clutch is compact and is built to withstand long service. It is easily incorporated in the design of a machine or product, and can be readily installed and adjusted to suit running conditions. The power transmitting capacity is 1 H.P. at 100 R.P.M., the capacity being proportionately smaller or larger as speeds decrease or increase up to the maximum of 6 H.P. The toggle action passes "over center" to lock the clutch in the driving position, and provides an easy engagement and powerful pull.

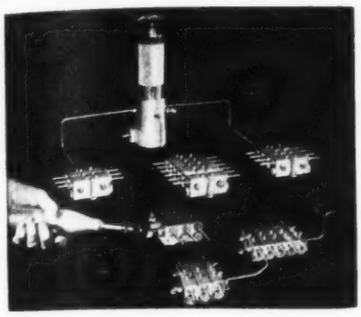
Rockford LMC Clutch

The clutch plates are of steel, hardened and ground, and the specially selected facing material is securely fastened in place. Pressure for driving is uniformly distributed and applied directly opposite the facing. No oiling is necessary for the metal bushing which carries the driven sprocket, pulley, sheave, flange, or other part of the machine in which the clutch is installed. The end-plate is threaded for fine adjustment. 80

Van Dorn Center-Drive "Scrugun"

A center-drive "Scrugun" designed for operation in a suspended position has just been placed on the market by Van Dorn Electric Tool Co., 735 Joppa Road, Towson, Md. The spindle of this tool is centrally positioned to facilitate application to the work, and the bonnet grip or paddle switch arrangement eliminates the need for handles. It will operate in reverse at full power when equipped with a reversing switch. The new "Scrugun" is available with either positive or adjustable clutch for driving self-tapping screws up to No. 12 size and machine screws and nuts up to 1/4 inch in diameter. The no-load speed of the tool is 750 R.P.M., but speeds of 500, 1000, or 1250 R.P.M. can be supplied. 81

To obtain additional information on equipment described on this page, see lower part of page 154.



Trabon Lubrication Systems, Including Six-outlet Distributor Operated Manually with a Pressure Gun

Single-Pipe Centralized Lubrication System

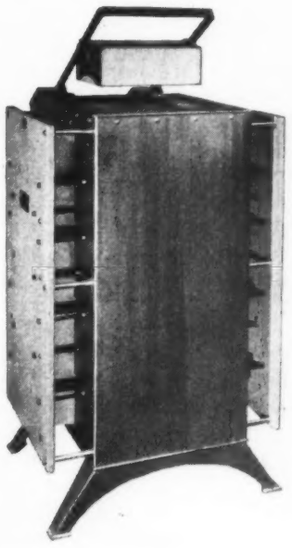
The Trabon Engineering Corporation, 1814 E. 40th St., Cleveland, Ohio, has recently placed on the market a new single-pipe, non-reversing, centralized lubrication system for use with automatic machines, steel mills, conveyors, forging, foundry, and hobbing machines, lathes, milling machines, plate mills, and similar machines and equipment.

This improved distributor consists of a bank of three or more sections, each of which discharges a measured quantity of lubricant alternately through one of two outlets which are directly connected to the bearings to be lubricated. The capacity of the different sections of the same distributor varies from 0.005 to 0.035 cubic inch. By selecting the correct number and capacity of sections, and supplying the proper kind of lubricant to the inlet, a single distributor discharging progressively through one outlet after another will deliver just the desired amount of lubricant to all the connected bearings, even though the individual bearings have widely varying requirements. The distributors will handle either oil or grease as a lubricant. 82

Controlled-Atmosphere Pit Type Furnace

A controlled-atmosphere, pit type furnace for high-temperature hardening of high-speed steel has been brought out by the Sentry Co., Foxboro, Mass. Its design permits the hardening of long tools in a vertical position, and eliminates any tendency of the tools to warp or change shape when hot. An automatically controlled neutral atmosphere is provided by Sentry Diamond Blocks.

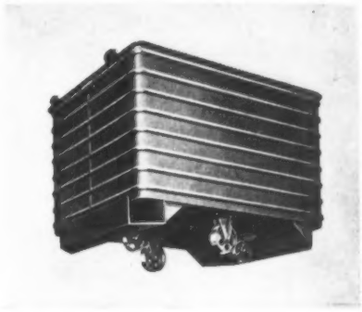
This new furnace has a maximum rating of 32 kilowatts, normal operation requiring from 8 to 20 kilowatts per hour. Starting from the cold state, it will raise the temperature to 2350 degrees F. in about seventy-five minutes. It has a rugged steel shell and ample insulation for operation at a temperature of 2500 degrees F. Heating elements on each side of the removable silicon-carbide muffle, in four positions, assure uniform temperatures throughout the chamber. Shielded electric terminals of a patented air-cooled design are provided to eliminate the necessity for water-cooling. The over-all dimensions of the furnace illustrated are height, 52 1/2 inches; width, 28 7/8 inches; depth, 21 1/2 inches. The muffle dimensions are 4 1/2 by 4 by 28 inches deep. 83



High-speed Steel Hardening Furnace Built by Sentry Co.

Steel Dump-Box for Lift-Truck

A corrugated-steel dump-box designed especially for use with lift-trucks equipped with revolving type forks has been developed by the Union Metal Mfg. Co., 1400 Maple Ave., N. E., Canton, Ohio. The truck forks can be inserted in the special pockets welded to the bottom of the box at each end. These pockets extend the full length of the box and permit it to be lifted, turned completely over for dumping, and then returned to the upright position. The top flange of the box can be equipped with tiering or crane lugs for convenient handling. This box is suitable for handling scrap, small metal parts, castings, and various loose materials. 84

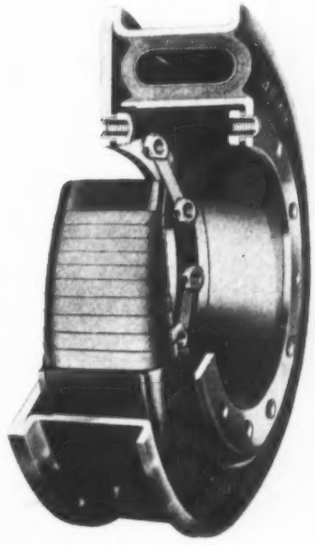


Dump-box for Lift-truck with Revolving Type Forks, Made by Union Metal Mfg. Co.

Falk "Airflex" Flexible Coupling

The Falk Corporation, Milwaukee, Wis., has placed on the market a new type of flexible coupling designated the "Airflex." This coupling is especially designed for connecting Diesel, oil, gasoline, or gas engines to any type of driven machine. It is also adapted for coupling motors to driven compressors, single-cylinder pumps, and similar equipment in which the torque is of a fluctuating nature.

The degree of resiliency of the coupling can be readily changed to



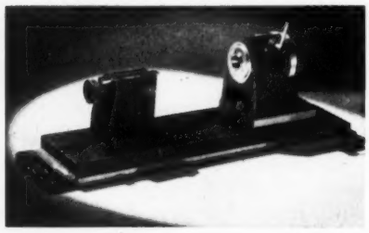
Coupling in which Flexibility is Controlled by Adjusting Air Pressure in Rubber Gland

To obtain additional information on equipment described on this page, see lower part of page 154.

suit the requirements of a particular application by means of a rubber gland lined with a premolded, prevulcanized, cylindrical section, especially treated to prevent air loss. The gland is inflated by proper pressure through a specially designed standard-thread valve which will take any hand-pump fitting or air nozzle. The degree of elasticity can be varied by changing the air pressure. 85

Hardinge Collet Index Fixtures

A new horizontal collet index fixture, tailstock, and sub-base have been brought out by Hardinge Brothers, Inc., Elmira, N. Y., to provide interchangeable assemblies. The HV-4 horizontal-vertical collet index fixture previously developed is also

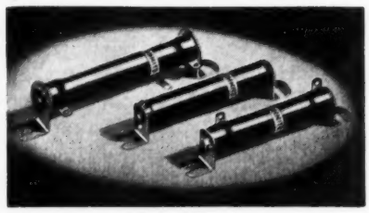


Hardinge H-4 Horizontal Collet Index Fixture

interchangeable with the new units. The spindle of the new H-4 horizontal collet index fixture is hardened and ground for a taper seat in the fixture frame. It takes 1-inch capacity 5C Hardinge collets and is provided with a 24-hole index-plate. The Type H-O fixture is of similar design, except that a 20-hole index-plate is provided. The center height of both of these fixtures is 4 inches. Both are provided with removable keys, 1/2 inch wide, for parallel or right-angle fitting to sub-base or machine table.

The SB-4 sub-base has a 21 1/4-inch by 4 7/8-inch surface for fixtures and tailstock mounting. The maximum center distances obtainable on this sub-base are 11 inches with H-4 horizontal fixture and T-4 tailstock; 10 inches with HV-4 horizontal-vertical fixture and T-4 tailstock; and 13 inches with two T-4 tailstocks.

The T-4 tailstock has a 5/8-inch diameter spindle and a travel of 1/2 inch. The center height is 4 inches. This fixture also is provided with removable keys for parallel fitting to sub-base or machine spindle. 86



Ohmite Wire-wound Vitreous Enameled Resistors

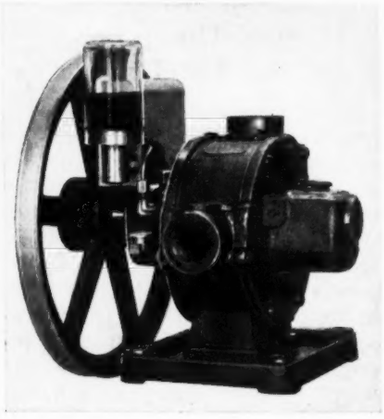
Ohmite Wire-Wound Resistors

Wire-wound, vitreous enameled resistors have been made available in "live" and "dead" bracket types for special applications by the Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill. The "live" bracket type resistors have flexible leads connected to tin-plated brass brackets, and mounting and electrical connection are accomplished by bolting the slotted brackets to panel terminals. The "dead"" bracket type resistors are mounted by bolting to the brackets. One, two, or three resistors of this type can be mounted on the same set of brackets by means of through-bolts. Electrical connections are made separately to the lugs.

Both types of resistors are used for signal circuits, electrical refrigeration controls, storage battery charging, switchboards, and other applications. They are available in a wide range of core sizes. 87

Automatic Mechanical Metering Lubricator

Leiman Bros., Inc., 101-H-7 Christie St., Newark, N. J., have brought out a single mechanical automatic



Automatic Mechanical Lubricating System Made by Leiman Bros., Inc.

lubricator which can be fastened to any machine or device requiring the lubrication of a moving part. Frictional contact between the rotating attachment of the lubricator and the revolving surface of any shaft furnishes the means of starting and stopping the flow of the oil, which can be adjusted to feed one drop in ten minutes or ten drops in one minute. With this arrangement, the lubricant is fed only when the machine is in operation. 88

Williams "Spatter Resisting" Clamp for Welding Service

J. H. Williams & Co., 225 Lafayette St., New York City, are now providing a special "spatter resisting" finish on their drop-forged C-clamp, which will resist the ad-

Williams "Spatter Resisting" Welding Clamp

herence of welding spatter to the body, swivel, and screw. These completely cadmium-plated clamps are available in seven sizes, with capacity openings ranging from 2 to 12 inches. 89

Link-Belt Flat-Box Babbitted Bearing

A new common flat-box bearing designed for moderate speed and power requirements has recently been announced by the Link-Belt Co., 2410 W. 18th St., Chicago, Ill. In this bearing, the sloping surfaces between the cap and base maintain concentricity and relieve the cap bolts of direct strain from side thrust. Removable shims between the base and cap provide for adjustment. The design is such that the cap bolts do not protrude above the top of the bearing. The babbitt is of a balanced formula, selected by tests, for maximum service.

The base is recessed to compensate for inaccuracies in the surface of the structural support, and elongated holes for hold-down bolts provide adjustment for shaft alignment. This

To obtain additional information on equipment described on this page, see lower part of page 154.

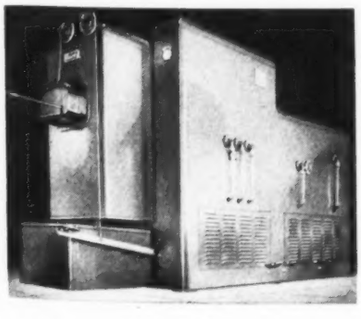
Babbitted Bearing Made by the Link-Belt Co.

bearing is available from stock in twenty-four sizes for shafts from 1/2 inch to 3 inches in diameter. 90

Lithco Heat-Treating Furnaces

A new series of gas-fired, controlled-atmosphere furnaces for heat-treating has been placed on the market by the Lithium Corporation, Raymond-Commerce Bldg., Newark, N. J., under the trade name of "Lithco." These furnaces utilize the specially developed Lithco compound, which is supplied in convenient cartridge refill form and provides an atmosphere that absorbs any oxygen released from water vapors, air, carbon dioxide, or other gases. Both alloy and carbon steels can be heated in these furnaces without decarburization, carburization, scaling nitriding, or hydrogen embrittlement. Steels of any carbon analysis can be heated simultaneously. Air-cooling can be accomplished without scaling.

Control of the Lithco atmosphere furnace is fully automatic. The Model HU-812-4 furnace illustrated has a temperature range of from 1200 degrees F. to 1800 degrees F. The furnace is completely insulated with 13 1/2-inch walls, and is equipped with special venting tubes to provide recirculation for uniform muffle temperatures. 91



Lithco Heat-treating Furnace with Neutralizing Atmosphere

Improved Universal Collet Chucks

The line of collet chucks made by the Universal Engineering Co., Frankenmuth, Mich., is now being furnished with a new type nut in the three larger collet chuck sizes, Z, ZZ and XZ, which reduces the locking effort by 50 per cent. With the new construction, the nut is tightened against a floating sleeve, as shown in the illustration, instead of directly against the collet. This reduces friction and makes the locking action

Improved Collet Chuck Made by the Universal Engineering Co.

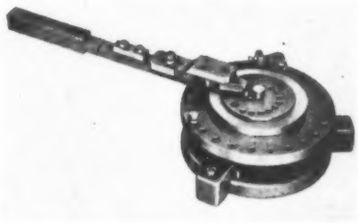
easier and more positive. The nut has a jet-black, rustproof finish, and is fluted for a spanner wrench. 92

G-E Arc-Welding Electrodes

Three new shielded-arc electrodes, Types W-30, W-83, and W-93, have been brought out for specific types of arc-welding work by the General Electric Co., Schenectady, N. Y. All three types of electrodes are heavily coated, and will operate on either direct or alternating current. The Type W-30 is an A.W.S. E-6012 all-position electrode, especially designed for automotive and other work where high currents are desired for high-production lap- or fillet-welding.

The Type W-83 electrode is intended for job welders or manufacturers engaged in the fabrication or repair of cast-iron work. It is an all-position electrode, and its outstanding advantage is its ability to operate at relatively low currents.

The Type W-93 electrode is designed for building up steel surfaces to resist wear from shock, abrasion, or rolling impact. Its extremely smooth arcing characteristics, freedom from spatter, and wide coverage—74 square inches per pound—make it well suited for such applications as agricultural implements, battered rail ends, snowplow shoes, and tractor treads. ... 93



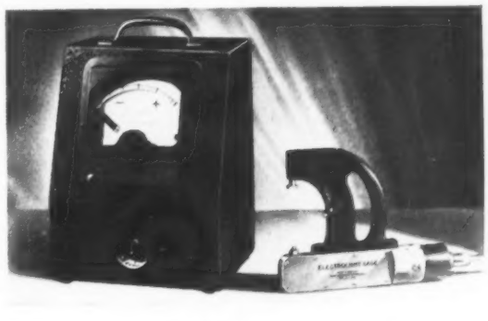
Bender with Capacity for Forming 1/2-inch Bar to 1/2-inch Radii

Micro Die Duplicating Bender

A No. 2 Micro die duplicating bender similar in design to the machine illustrated and described in November, 1940, MACHINERY, page 194, but of larger capacity, has been placed on the market by the O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn. This new bender was brought out in response to the demand for a machine capable of handling larger work. It is especially adapted for forming seamless-steel tubing and gasoline and oil lines for aircraft construction work. Heavy forming operations on bus-bars, such as are used in power transmission and switch control work, where the material is held both on edge and vertically, can also be performed on this bender. 94

Pratt & Whitney Electrolimit Snap Gage

A new type of snap gage employing the Electrolimit principle has been developed by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn. This equipment consists of a gage body in which the mechanically actuated armature and electrical coils are placed, a set of frames for attachment to the gage body, a connecting



Electrolimit Snap Gage Designed to Measure to 0.0001 Inch

To obtain additional information on equipment described on this page, see lower part of page 154.

MANAGEMENT–
SET-UP MEN–
OPERATORS– ALL F

Experienced Hands and Set-up Men

appreciate these operating helps

- Quick, accurate set up
- Broad feed and speed ranges
- Fast metal-removing ability
- Smoothness of operation

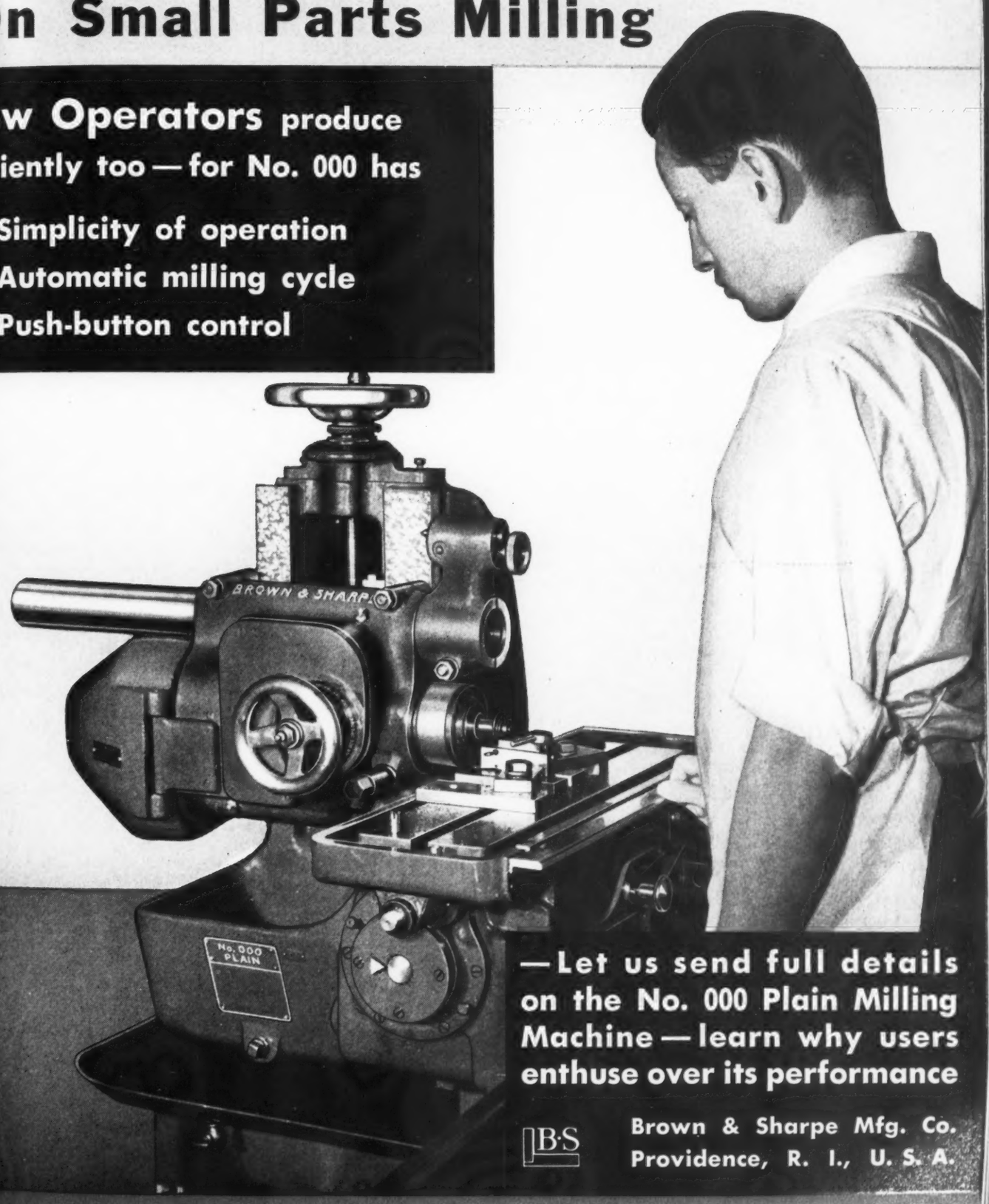
BROWN &

FIND Nº 000 IDEAL

On Small Parts Milling

New Operators produce efficiently too — for No. 000 has

- Simplicity of operation
- Automatic milling cycle
- Push-button control



— Let us send full details on the No. 000 Plain Milling Machine — learn why users enthuse over its performance

B·S Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

SHARPE

cord, and an electric indicating instrument with a scale graduated for both plus and minus readings. The gage is designed to measure to ten-thousandths of an inch, and the electric circuit magnifies any dimensional variation in the part measured into an easily read needle deflection against the meter dial. Many of these gages are being used in aircraft and tank production where fine tolerances are specified.

Two gage bodies are available and several sizes of frames for each body. The possible combinations of these permit the gaging of dimensions from 1/2 inch to 6 inches. The two smallest frames have a 1/4-inch adjustment, and all others a 1/2-inch adjustment. When several diameters are to be checked, a portable instrument cabinet with selector switch and connections for several gage heads is available. This arrangement may be more desirable for production purposes than using one gage body and several interchangeable frames. 95

* * *

Navy Officials Inspect Westinghouse Lester Plant

On April 11, Ralph A. Bard, Assistant Secretary of the Navy, together with many high ranking officers, inspected the steam turbine apparatus under construction at the Westinghouse Steam Division plant at Lester, Pa. This plant is now working twenty-four hours a day, turning out propulsion equipment for naval vessels to the extent of 7,000,000 H.P., besides turbines for power plant and industrial use totalling 2,400,000 H.P. The company is spending $9,000,000 for this plant alone in new buildings, machine tools, and equipment. The plant employs approximately 5000 people, working three shifts. About three hundred apprentices are being trained there.

* * *

Hot Saw Operated at Exhibition

The United States Steel Corporation will have an unusual exhibit at the Show to be held in connection with the convention of the National Association of Purchasing Agents at the Stevens Hotel, Chicago, Ill., May 26 to 29. One of the most colorful sights of the steel industry—a hot saw cutting red-hot sections of steel pipe—will be seen at this exhibit.

A British Tribute to the American Machine Tool Industry

May we be allowed to pay a high tribute to the magnificent help that the American machine tool manufacturers have given, and are giving, to the British Empire in aiding the defense of liberty and all that we hold dear?

Early last year several firms advised us that they had built an extension to increase production; and within twelve months they have extended their plants three times. They have also cut out certain models and rearranged their production to permit of greatly increased output. They have run their works night and day, either by three shifts, or by two shifts, each with over-time. Extensive training plans have been put into operation.

Now the National Machine Tool Builders' Association estimates that the total output of machine tools for 1941 will be around $600,000,000. We tender our great appreciation and thanks to all concerned in this splendid achievement.

Yours faithfully,

CATMUR MACHINE TOOL CORPN.
T. S. Catmur, Managing Director
London, England

[Since the time that Mr. Catmur received the estimate of an output of $600,000,000 for 1941, the members of the National Machine Tool Builders' Association have again stepped up their output, and the latest estimate is that production in 1941 will be valued at not less than $750,000,000 —EDITOR.]

Priorities for Steel for Small Tools

Many manufacturers of small tools and accessories absolutely necessary in the manufacture both of war materials and of the machine tools on which war materials are made complain that it has been difficult for them to secure a priority rating which would enable them to obtain steel in sufficient quantity to maintain the production of which their plants are capable. It is perfectly obvious that priorities in machine tools are of no avail if the tools and accessories required in their operation are not obtainable; and it is equally obvious that these tools and accessories cannot be manufactured unless the concerns that make them can obtain steel.

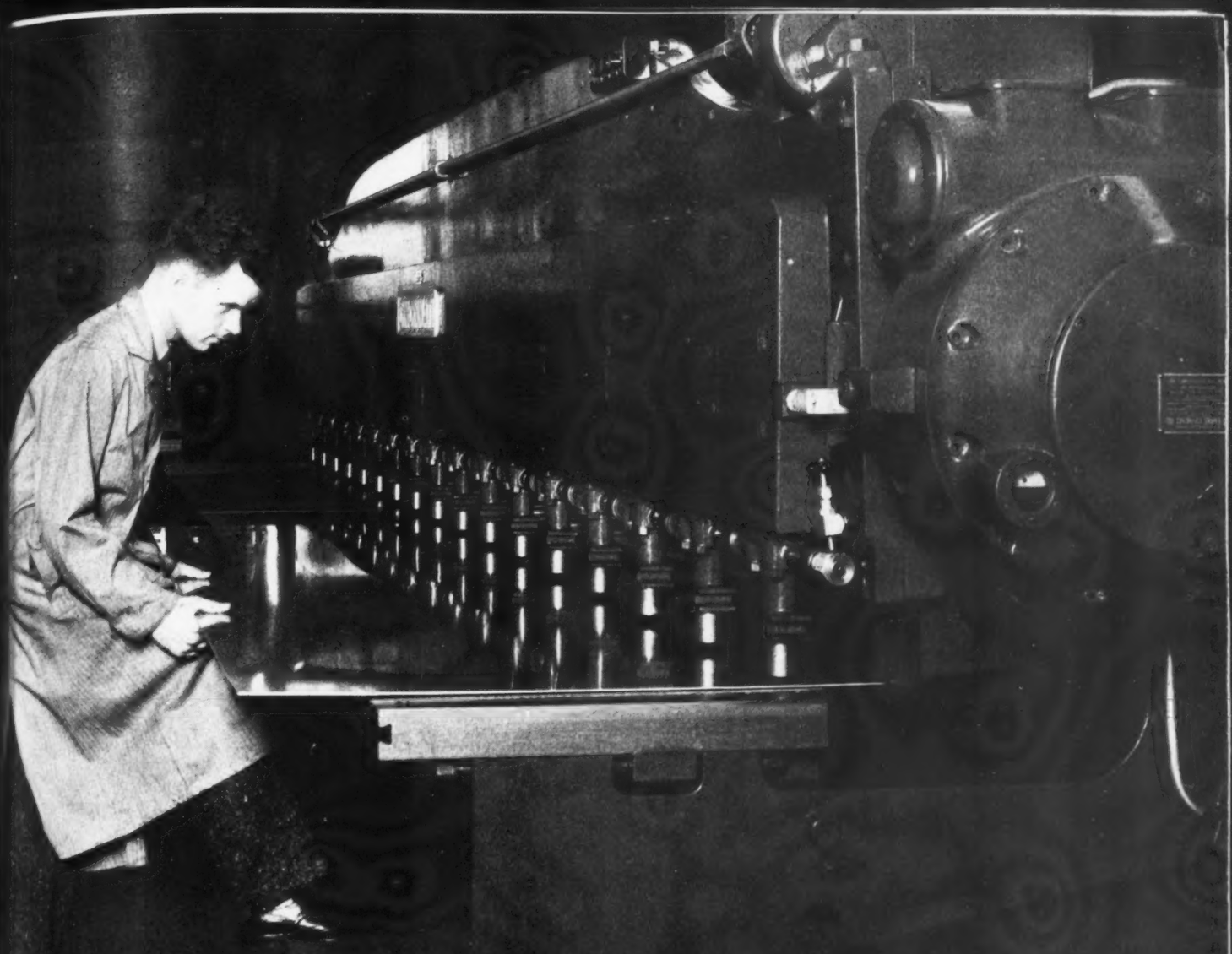
As a specific example, a manufacturer who makes the centers used on an important line of machine tools was unable to secure a priority so that he could buy the steel to manufacture these centers; yet the machine tools were useless without the centers. It appears that somewhere a cog has slipped. Doubtless, the condition will be corrected as soon as those in authority are thoroughly impressed by the necessity of giving manufacturers of tools and accessories a priority rating to enable them to obtain the materials required. Since the business of most of the manufacturers of small tools and accessories consists of a great many small orders, it is obvious that they cannot operate under the priority numbers of their individual customers; but what they require is a blanket "priority" to buy steel for their requirements, if their business is mainly for defense purposes.

* * *

Cooperation between Machine User and Builder Cuts Delivery Time

In the General Electric Co.'s Erie, Pa., plant, new facilities are being set up in two buildings, one for the manufacture of turbines, and one for gun mounts. New machine tools—boring mills and lathes—are needed before the work on the turbines can get under way. The manufacturer who is to build these machines—the Niles Tool Works Co., Hamilton, Ohio—stated that it was impossible to deliver them before October. Then the General Electric Co. and the Niles Tool Works Co. discovered that parts for both the lathes and boring mills could be machined in the General Electric Co.'s gun mount division. Accordingly, these operations are being performed at the Erie works, and the parts are then shipped to the Niles plant for assembly. The process has resulted in advancing the delivery date for the first machines from October to June, and the General Electric Co. will be able to go to work on the turbines more than three months earlier than expected.

To obtain additional information on equipment described on this page, see lower part of page 154.



A MACHINE TOOL FOR SHEARING METAL

Cincinnati *All-Steel* SHEARS

Write for
Catalog S-2

See a Cincinnati in action before you buy your next shear. All-steel construction, hydraulic holddowns, micrometer ball bearing backgauge, positive knife adjustment automatically assure continuous accurate results. Sizes for every requirement from 0.005" aircraft aluminum alloy to 1¼" steel plate.

THE CINCINNATI SHAPER CO.

SHAPERS · SHEARS · BRAKES

CINCINNATI, OHIO.

Gantt Medal Awarded to William L. Batt for Leadership in Management

The Henry L. Gantt Memorial Gold Medal for "distinguished and liberal-minded leadership in the art, science, and philosophy of industrial management in both private and public affairs" has been awarded to William L. Batt, president of the S K F Industries, Inc., Philadelphia, Pa., who is also serving at present as deputy director, Production Division, Office of Production Management, Washington, D. C.

The medal was presented to Mr. Batt at the Engineers Club in Philadelphia, Tuesday evening, April 22, by William A. Hanley, president of the American Society of Mechanical Engineers, during a dinner held in conjunction with the two-day management conference on National Defense sponsored by the Society. Mr. Batt was introduced as recipient of the medal by Dr. A. P. Alford, chairman of the Gantt Medal Board of Award, who is also head of the Department of Administrative Engineering at the New York University.

In addition to his present duties in Washington and as president of the S K F Industries, Mr. Batt is chairman of the Business Advisory Council of the U. S. Department of Commerce; chairman of the Division of Engineering and Industrial Research of the National Research Council; chairman of the board of the American Management Association; and president of the International Committee on Scientific Management.

In 1936, he was president of the American Society of Mechanical Engineers, and in 1938, he acted as chairman of the executive committee of the International Management Conference held in Washington, D. C. In 1933, Purdue University, his alma mater, conferred upon him the degree of Doctor of Engineering. In 1926, King Gustav of Sweden decorated him with the Order of Vasa, and in 1933, with the Royal Order of the North Star, for his work in promoting commercial relations between that country and the United States.

In connection with his work as deputy director in the Production Division for National Defense, Mr. Batt handles the coordination of the manufacture of aircraft, machine tools, shells, merchant and naval ships, and other war equipment that requires the mobilization of industry. Recently he has given a score or more of addresses in various parts of the country to acquaint labor, management, and the public with their part in the National Defense Program.

Aircraft Welding Prize Contest

On page 184, March MACHINERY, a contest was announced relating to a series of prizes to be awarded by the Summerill Tubing Co., Bridgeport, Pa., for papers relating to the art of welding aircraft steels, including tubing and other steel parts for tubular assemblies. The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, announces that papers submitted in the Summerill contest will also be eligible for submission in the $200,000 Industrial Progress Award Program sponsored by the James F. Lincoln Arc Welding Foundation, provided, of course, that the papers comply with the Foundation's rules and conditions as regards subject matter and form. A paper entered in the Summerill contest would probably be written in such a way as to be acceptable in the Lincoln Program. If not acceptable as written, the author, by a few changes or additions, could doubtless make it conform to the Foundation's requirements.

* * *

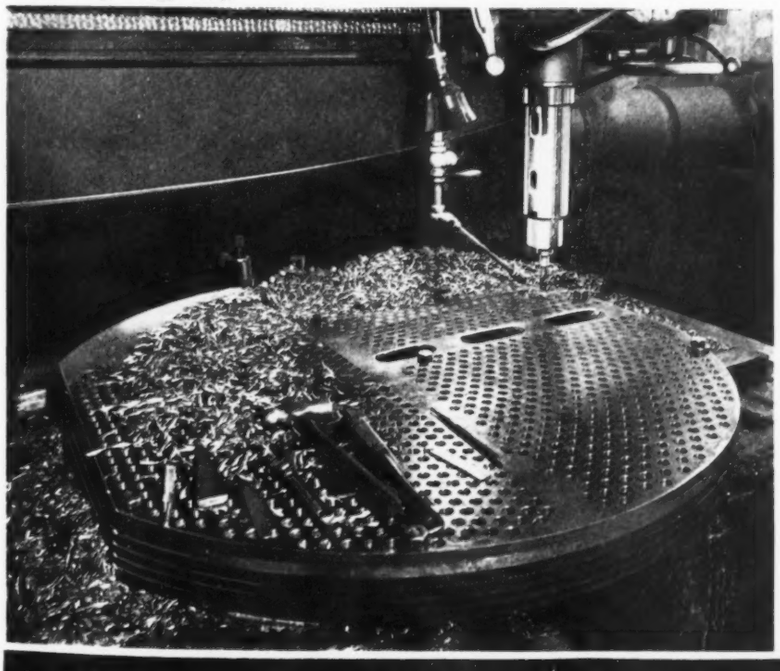
The American Gear Manufacturers Association reports that industrial gear sales for March, 1941, were 152.6 per cent above the sales for March, 1940.

The Monarch Machine Tool Co., Sidney, Ohio, whose slogan is "National Defense Cannot Wait," has completed the $150,000 plant addition here illustrated in sixty days from the day ground was broken. The machines in the foreground are already at work; other machines are being placed in operation the minute they are installed. New machine tool equipment to the value of $500,000 will be operated in the new addition. In 1940, the Monarch Machine Tool Co. built two and one-half times as many lathes as in 1939. The company expects to build twice as many lathes in 1941 as in 1940, making the production five times that of two years ago

N. Y. S. Corp. selects 'THE SUPER SERVICE RADIAL DRILL

to improve accuracy and ease-of-handling in Radial Drilling Department

In these photographs from the N.Y.S. Corp., note how the speed, feed, column and arm clamping, hand and power traverse, and elevation control are concentrated at the head—within easy reach. These and other Super Service features are illustrated in Bulletin R-24. Write for your copy today.



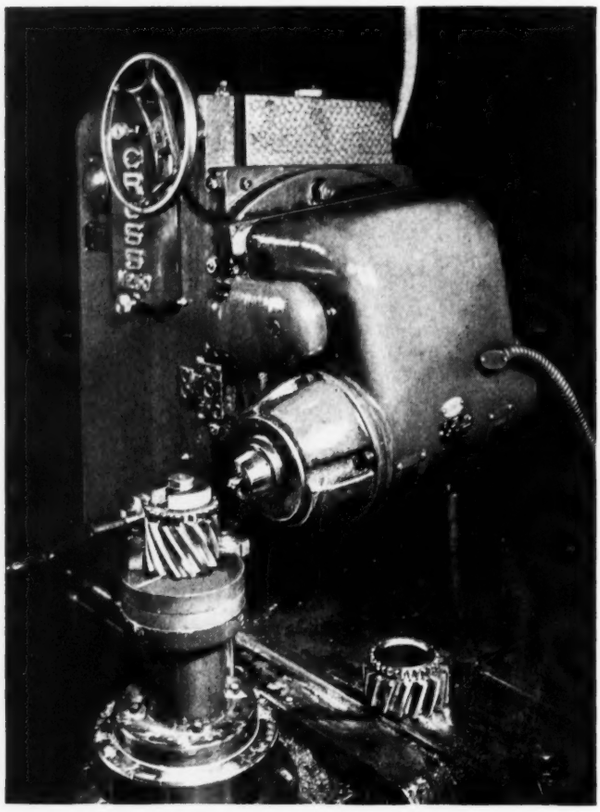
In numerous shops now producing rush National Defense work, in Navy Yards and Shipbuilding plants, the Cincinnati Bickford Super Service Radial is daily proving its worth by delivering "more holes per dollar". Here, for example, is an action photograph from the New York Shipbuilding Corporation showing the Super Service Radial drilling 1578 holes in each Navy auxiliary condenser tube support sheet — drilling through five sheets at one setting. Thickness of each sheet is 9/16", holes are 41/64" dia., and accuracy is held to +.005", —.0" at the rate of about 250 holes per hour. This represents a savings of 20% as compared with the method previously used. The N.Y.S. Corp. voices the opinions of many plants engaged in Defense production when it reports that the Super Service Radial not only meets high quantity production requirements, but also demonstrates a definite "improvement as to accuracy, speed and ease-of-handling".

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

Rounding the Ends of Clutch Teeth on Helical Drive-Pinions

Clutch teeth on helical drive-pinions are rounded in the plant of the Timken-Detroit Axle Co., Detroit, Mich., by a Cross gear-tooth chamfering machine set up as shown in the accompanying illustration. This rounding operation provides the teeth with the relief essential to easy gear shifting. The "pencil point" cutter of the chamfering machine slides back and forth at an angle between indexings of the pinion. The cutter-head is



Rounding the Ends of Clutch Teeth on Drive-pinions by the Use of a Cross Gear-tooth Chamfering Machine

automatically moved vertically on the column between indexings, so as to enable successive clutch teeth to be rounded to two different heights. The machine is so constructed that the cutter-head and work-spindles can be tilted to the required angles. The cutter-spindle runs at 3500 R.P.M.

* * *

New Car Wheel for High-Speed Service

After five years of research, the American Rolling Mill Co., Middletown, Ohio, has developed a new railroad passenger car wheel for high-speed service that provides an additional margin of safety and durability. A wheel-testing machine, the first of its kind, was designed to study wheels under identical conditions to those that prevail in railroad service. The new wheels will be made at the Armco Wheel Works, Butler, Pa.

A.S.M.E. Management Conference on National Defense

A management conference on national defense was held under the auspices of the American Society of Mechanical Engineers at the Engineers' Club, Philadelphia, Pa., April 22 and 23. The meeting was sponsored by the Management Division and the Philadelphia Section of the Society. Papers were read dealing with successful methods of planning and coordination in subcontracting; degree of personal contact between principal and sub-contractor; selection and training of defense personnel; speeding learner programs; training foremen and sub-foremen; labor problems under national defense; viewpoints of labor, management, and government; quality control; tooling; organizing to keep spoiled work at a minimum; salvaging spoiled work; supervision of learners; and inspection.

* * *

Eye Protection in Welding, Furnace, and Foundry Operations

Speaking before the Massachusetts Safety Council, W. H. Lehmberg, of the American Optical Co., Southbridge, Mass., emphasized the danger of invisible rays generated in welding, furnace, and foundry operations. These rays are capable of causing serious injury if the eyes are not protected by lenses that absorb them. Ordinary dark lenses, Mr. Lehmberg stated, do not protect the eyes from these rays. The visible light is cut down by such lenses, but the harmful invisible rays may not be barred by the glass. The first warning of injury is eye irritation. Lenses are available, however, having a chemical content which absorbs the invisible rays. Glasses with such lenses should always be worn by workers who are exposed to invisible light radiation.

* * *

New Chapter of the American Society of Tool Engineers

The fortieth chapter of the American Society of Tool Engineers has been chartered in Springfield, Vt., with a membership of seventy. The officers of the new chapter are: Chairman, Wilbur Handey, chief tool designer, Fellows Gear Shaper Co.; vice-chairman, Merton Arms, chief engineer, Bryant Chucking Grinder Co.; secretary, Milan Jennings, tool engineer, Jones & Lamson Machine Co.; and treasurer, James H. Beardsley, assistant tool supervisor, Jones & Lamson Machine Co.

* * *

Manufacturers of electric arc welding rods announce that, with the installation of a relatively small amount of new equipment, the industry will have a capacity of about 400,000,000 pounds of welding rod annually. This is approximately twice the quantity of welding rods used in 1940. While a very large number of electric welding machines were sold in 1940, it is not believed that this will tax the rod production capacity appreciably, because, though the number of new machines was large, these machines constitute only a small part of the total machines actually in operation.

XLO

THE RECOGNIZED SYMBOL OF *Precision*

There's only one standard at Ex-Cell-O . . . the making of the finest precision machines and tools that the most highly trained engineers and craftsmen can produce. This is why the Ex-Cell-O symbol—whether on a large machine like a thread grinder or on a small cutting tool like a counterbore—is positive assurance of a precision built product to do a real precision job.

EX-CELL-O CORPORATION • DETROIT, MICH.

● *Ex-Cell-O produces* **THREAD GRINDING, BORING and LAPPING MACHINES, CARBIDE TOOL GRINDERS, GRINDING SPINDLES, HYDRAULIC POWER UNITS, BROACHES, CUTTING TOOLS, DRILL JIG BUSHINGS** (*Ex-Cell-O Automatic Thread Grinder No. 33 —one of eight styles—shown to right*).

EX-CELL-O CORPORATION
1212 Oakman Blvd., Detroit, Mich.

• Please send me folder on Ex-Cell-O precision machines and tools.

Name_____

Address_____

City_____ State_____

EX-CELL-O (XLO) *Precision* **MACHINES AND TOOLS**

NEWS OF THE INDUSTRY

California and Colorado

WILLIAM W. BRITTON has been made special representative for the Pacific Coast territory (including California, Oregon, and Washington) of the Jessop Steel Co., Washington, Pa. His headquarters will be in the Chamber of Commerce Bldg., Los Angeles, Calif.

GISHOLT MACHINE CO., Madison, Wis., has appointed the MINE AND SMELTER SUPPLY CO., Denver, Col., exclusive sales agent for the company in the Rocky Mountain region, representing the complete line of Gisholt turret lathes, automatic lathes, and balancing machines.

Illinois

S. H. HAMMOND, until recently manager of the Appliance Division of the Whiting Corporation, Harvey, Ill., is now in charge of all Whiting branch offices and sales representatives, with the title of director of the field forces. M. F. BECKER, vice-president and formerly field force director, has been promoted to the position of co-manager of the Equipment Division.

B. F. BOWER, chief engineer of the Howell Co., St. Charles, Ill., has resigned his position and is organizing a company to engage in the production of a line of high-speed tube bending, burring, and cut-off machines. Mr. Bower has spent many years in designing and perfecting tube-fabricating equipment.

N. T. COOPER, sales engineer with the Bakelite Corporation, Unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City, has been transferred from the New York metropolitan area to Chicago, Ill., where he will be located in the Carbide and Carbon Building, 230 N. Michigan Ave.

MAX L. ROBINSON, who has been promoting the sale of Janette motorized speed reducers for the last four years, has been appointed sales manager of the Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill.

GORDON E. GRAY has joined the organization of Ralph M. Hill, 1 N. Crawford Ave., Chicago, Ill., electrical manufacturers' representative, and will aid in the sale of electrical industrial lines.

RALPH M. HOFFMAN has been elected a vice-president of the Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill., and will assume the general direction and supervision of sales.

Michigan

FRANK W. CURTIS, chief engineer, Milling Machine Division, Van Norman Machine Tool Co., Springfield, Mass., was elected president of the American Society of Tool Engineers at the annual meeting of the board of directors. Mr. Curtis, formerly chairman of the Springfield Chapter of the Society, succeeds, as president, A. H. D'ARCAMBAL, chief metallurgist, Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn.

OTTO W. WINTER, factory manager of the Columbus McKinnon Chain Corporation, of Tonawanda, N. Y.,

Frank W. Curtis, Newly Elected President of the American Society of Tool Engineers

was elected the first vice-president; RAY H. MORRIS, vice-president, Hardinge Brothers, Inc., Hartford, Conn., second vice-president; CLYDE L. HAUSE, sales engineer, Gorham Tool Co., Detroit, Mich., secretary; and FRANK R. CRONE, chief tool designer, Lincoln Motor Co., Detroit, Mich., treasurer. FORD R. LAMB continues as executive secretary of the Society.

ENTERPRISE MACHINE PARTS CORPORATION, Detroit, Mich., has bought the patent rights and is now building Millholland unit mechanisms under the trade name "Empco." These units are adapted for drilling, milling, tapping, reaming, and spot-facing either singly or in multiple, and are especially designed for heavy work. It is stated that several improvements have been incorporated in these units.

New England

E. B. NISBET, formerly purchasing agent and treasurer of the Laminated Shim Co., Inc., Glenbrook, Conn., has been made executive vice-president of the company. E. R. YOUNG, the former factory manager, becomes vice-president in charge of production. RICHARD SEIPT has been appointed vice-president in charge of sales and will also continue to serve as sales manager.

ANTHONY J. CHENIS has recently joined the Bullard-Dunn Process Division of the Bullard Co., Bridgeport, Conn., having charge of the Bullard-Dunn Process Laboratory. Mr. Chenis was previously associated with Blacher Brothers, where he was in charge of finishing and plating.

GEORGE L. TODD, comptroller of the Bullard Co., Bridgeport, Conn., has been elected a member of the board of directors to fill the vacancy caused by the resignation of THOMAS E. DUNN, as noted in April MACHINERY.

FITCHBURG GRINDING MACHINE CORPORATION, Fitchburg, Mass., has recently purchased a modern, one-story factory building on Falulah Road, formerly occupied by the file manufacturing department of the Simonds Saw & Steel Co. The new quarters will afford double the former floor space. This move marks the thirty-fifth year of continuous operation of the company and its predecessors.

New York and New Jersey

DONALD J. REESE, engineer with the Research and Development Division of the International Nickel Co., Inc., New York City, will be awarded the J. H. Whiting Medal at the annual meeting of the American Foundrymen's Association, to be held in New York City during May. Mr. Reese is being awarded this medal for his outstanding contribution to the foundry industry through his work in the improvement of cupola melting methods.

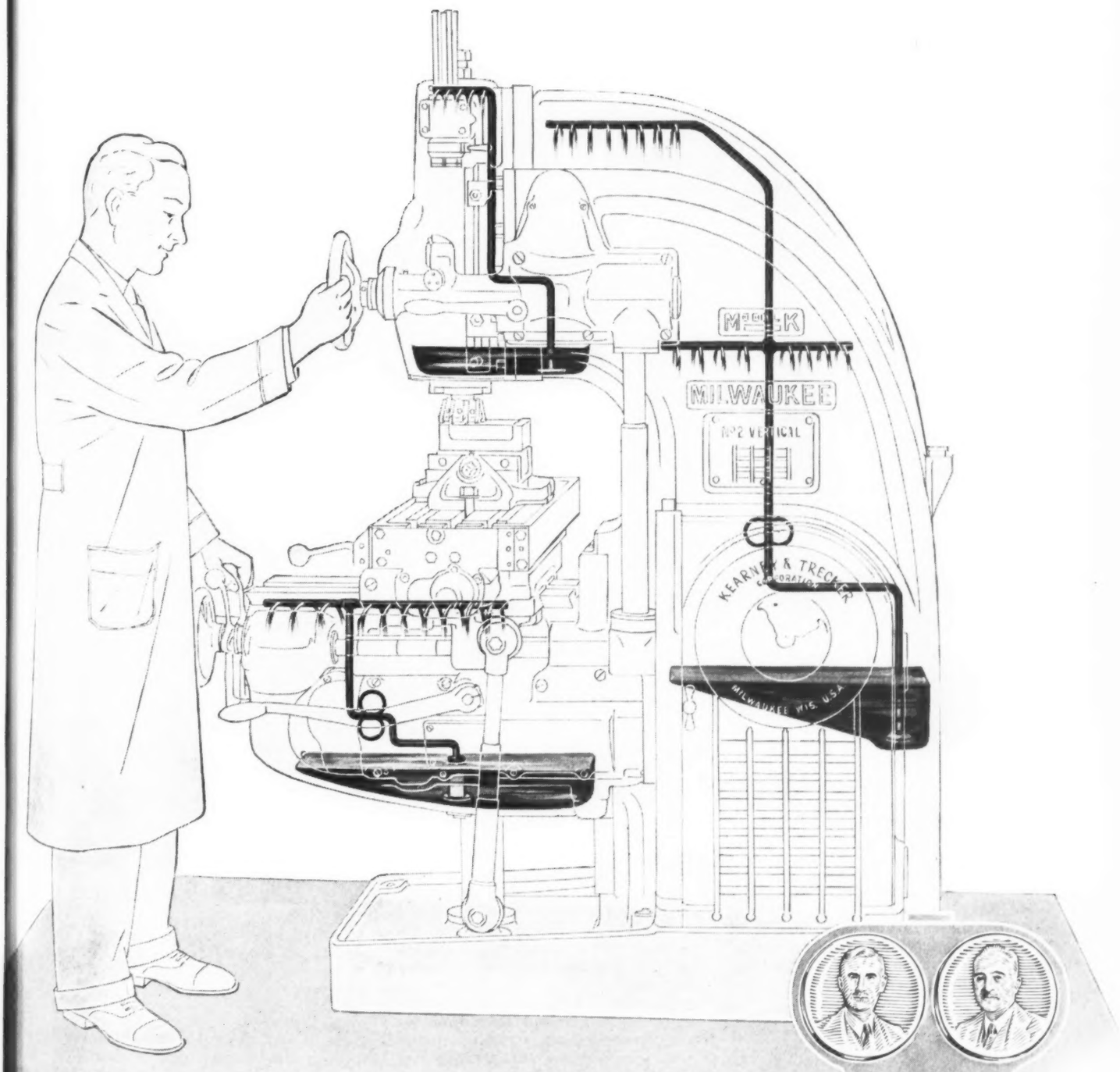
CHARLES F. NORTHUP, who has had charge of the Syracuse office of the Brown & Sharpe Mfg. Co., Providence, R. I., for the last twenty-nine years, has retired from active service. CHARLES J. VEVERA, who has been assistant to Mr. Northup for the last fifteen years, will take charge of the Syracuse office for the present.

AMERICAN CAR & FOUNDRY CO., 30 Church St., New York City, announces that the Madison and St. Louis car plants of the company have been combined under one management, with THOMAS A. DOOLEY as district manager in charge of both plants. NORMAN H. SHIPLEY is assistant district manager of the Madison car plant.

C. R. WADE, sales engineer of the Tool Steel Division of the Crucible Steel Co.

Lubrication—vital to the life of any machine—is provided in the Milwaukee Milling Machine by automatic pressure pumps in the column and knee, and in the sliding head on vertical machines. Automatic pump lubrication of this type requires only a minimum of attention.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.



KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

MILWAUKEE MILLING MACHINES

Louis Poock, New President of the Sheffield Corporation

of America, Halcomb Works, Syracuse, N. Y., recently addressed the Springfield, Mass., Chapter of the American Society for Metals on the subject "Tensile Properties of Metals."

STANLEY H. ROSE, for over nine years manager of the export department of J. L. Lucas & Son, Inc., Bridgeport, Conn., has severed his connection with the company. His office will continue to be located at 44 Whitehall St., New York City, for the present.

JAMES P. GILLIES has become connected with the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City, and will assist in general sales activities.

WILLIAM H. DUNN was elected treasurer of the Rubber Manufacturers' Association at a recent meeting. Mr. Dunn is secretary, director and comptroller of Raybestos-Manhattan, Inc., Passaic, N. J. H. E. SMITH, assistant general manager of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., was recently elected a member of the board of directors and of the executive committee of the company.

ANDREW HUTTON has been appointed works manager of the Robins Conveying Belt Co., Passaic, N. J., in charge of all manufacturing operations, buildings, and equipment. Mr. Hutton was previously chief engineer of the Davis Engineering Corporation, Elizabeth, N. J.

Ohio

Announcement has been made that the CIMATOOL CO. and the SHEFFIELD GAGE CORPORATION, E. 3rd at June St., Dayton, Ohio, have been merged into a single company to be known as the SHEFFIELD CORPORATION. The new corporation will continue to manufacture the products of the two original concerns, including precision measuring instruments and gages, standard machine tools, and special tools and dies. O. M. POOCK, formerly president of the Cimatool Co., was elected chairman of the board of the merged company; LOUIS POOCK, previously general manager of both companies, was elected president and general manager; and C. H. REYNOLDS, formerly president of the Sheffield Gage Corporation, was elected vice-president.

FOREST S. BASTER has been elected vice-president in charge of engineering of the White Motor Co., Cleveland, Ohio. Mr. Baster was previously chief engineer. ROBERT CASS, formerly executive engineer, will succeed Mr. Baster as chief engineer. O. F. QUARTULLO, who has been special design engineer, was made chief engineer of the White Horse Division of the company.

Pennsylvania

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., announces that the corporation has removed royalty restrictions on the manufacture of tools from its DBL low-tungsten, high-speed tool steel, a patented molybdenum high-speed steel containing less than one-third the amount of tungsten present in ordinary 18-4-1 high-speed steel. The granting of royalty-free, non-exclusive licenses for the manufacture of tools made from DBL steel is expected to reduce the present consumption of tungsten and thereby conserve the nation's supply of this metal for other important defense purposes.

HARRY L. STRUBE has been appointed chief engineer of the Eastern Division of the Link-Belt Co., with headquarters at the company's Philadelphia plant, succeeding F. F. WAECHTER, who has resigned after forty-three years of service. Mr. Strube was formerly assistant chief engineer at Philadelphia, first becoming connected with the company in 1910 in the engineering department of the Chicago plant.

F. J. STOKES MACHINE CO., Philadelphia, Pa., manufacturer of plastics molding presses, high-vacuum pumps, and other special equipment, has recently completed the construction of a new brick and concrete addition to its Tabor Road plant, which increases the floor space more than 50 per cent.

W. ALEXANDER MCCUNE, JR., has been appointed field engineer in the Abrasive Division of the Norton Co., Worcester, Mass., for the Philadelphia territory. Mr. McCune was previously in the laboratories and sales engineering department in Worcester.

Washington, D. C., and Maryland

B. J. BRUGGE has been appointed welding consultant and engineer at Washington, D. C., for the Lincoln Electric Co., Cleveland, Ohio. He will be engaged in consulting work having to do with the application of arc welding in the National Defense Program, and will be available for such work to all governmental departments. Mr. Brugge, who has been associated with the Lincoln Electric Co. since 1931, was formerly in the Los Angeles office, and until recently located in Houston, Tex.

B. J. Brugge, Welding Consultant at Washington, D. C., for the Lincoln Electric Co.

W. K. EBEL, chief engineer of the Glenn L. Martin Co., Baltimore, Md., has been made vice-president in charge of engineering and a director of the company.

Wisconsin

R. L. HAMILTON was elected vice-president of the Dumore Co., Racine, Wis., at a recent meeting of the stockholders. Mr. Hamilton has been connected with the Dumore Co. since his

R. L. Hamilton, Recently Elected Vice-president of Dumore Co.

graduation from the University of Notre Dame in 1934. He has been sales manager since 1938.

LEE H. HILL has been appointed assistant manager of the electrical department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Mr. Hill has been head of the company's transformer department since 1936.

W. H. PRITCHARD has been appointed assistant purchasing agent of the Kearney & Trecker Corporation, Milwaukee, Wis. Mr. Pritchard has been connected with the company for about five years, in various capacities in the cost and sales departments.

* * *

Toledo Welding School in Continuous Session

The Macomber Vocational School, Toledo, Ohio, is operating continuously twenty-four hours a day to meet the demands for trained welders for the National Defense Program. This welding school conducts both vocational trade-school classes and courses in connection with defense. The regular course covers a period of sixteen weeks, six hours a day. Twenty-eight students are accommodated, eleven of which are in the arc-welding division. The equipment of the school includes four 200-ampere "Shield Arc" welders supplied by the Lincoln Electric Co. of Cleveland.

NEW BOOKS AND PUBLICATIONS

LABOR AND NATIONAL DEFENSE. 130 pages, 5 1/2 by 8 inches. Published by the Twentieth Century Fund, 330 W. 42nd St., New York City. Price, $1.

In view of the timeliness of the subject and the great public interest in labor problems, this report analyzing labor needs, labor supply, and labor problems under the Defense Program will undoubtedly be welcomed. The survey on which the report is based was conducted by a special research staff, headed by Lloyd G. Reynolds of Johns Hopkins University. The first four chapters of the book contain facts regarding methods of meeting labor shortages, such as vocational school and apprenticeship training plans, employment services, etc.; labor standards, including working hours and wages; adjustment of industrial disputes through collective bargaining and through government agencies. The last chapter contains a program suggested by a labor committee appointed by the Twentieth Century Fund to meet the problems arising along these lines. The recommendations are worthy of careful study.

AIRCRAFT TUBING DATA. J. E. Younger, Consulting Editor. 135 pages, 8 by 11 inches. Published by the Summerill Tubing Co., Bridgeport, Pa. Price, $1.50; with ring binder, $2.

This is a new edition of a publication on aircraft tubing. The material is issued in loose-leaf form. There are four sections in the book, the first of which covers manufacture of tubing, heat-treating, specifications, tolerances, and special shapes; the second section deals with welding, inspection, and bending; the third section contains tables of tube properties, column curves, and other design data; and the fourth section contains commonly used tables, such as areas and circumferences of circles, tables of squares, cubes, square roots and cube roots, decimal and metric equivalents of parts of an inch, metric conversions, etc.

HANDBOOK OF WELDED-STEEL TUBING. 86 pages, 4 3/4 by 8 1/4 inches; bound in a loose-leaf binder. Published by the Formed Steel Tube Institute, 1621 Euclid Ave., Cleveland, Ohio. Price, $1.

This little handbook has been published to furnish design engineers with complete information regarding standard sizes and properties of welded tubing. Standard sizes, together with commercial tolerances for roundness, wall thickness, straightness, etc., are tabulated for various grades of welded tubes. The manufacturing and fabricating processes are illustrated, and recommendations are included for laying out fabricated parts, as well as information on methods of checking. Suggestions are given to aid in developing designs for the economical use of tubular sections.

THE SELECTION OF PRESSES. By S. D. Brootzkoos. 111 pages, 5 1/2 by 8 1/4 inches. Published by the Dryden Press, Inc., 103 Park Ave., New York City. Price, $2.

The aim of this book is to assist the user of presses to select the size and capacity suitable for the work at hand. The principles underlying the action of mechanical and hydraulic presses are explained by the aid of simple charts and drawings. These charts and drawings, as well as numerous tables, enable the reader to find directly the pressure requirements of the work to be done, the actual pressure capacities that mechanical presses can exert at various points of their stroke, and the rated pressure capacities of the presses accepted by the trade.

RUNNING AN ENGINE LATHE. By Fred H. Colvin. 117 pages, 5 by 7 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $1.25.

This little book contains information for the young machinist or apprentice on the basic principles of engine lathe work. The material is divided into thirteen chapters, covering the following subjects: The Engine Lathe; Centering Lathe Work; Driving the Work; Tools and Turning; Steady and Follower Rests; Faceplate Work; Chucks and Chucking; Boring Tools; Taper Turning; Cutting Screw Threads; Test Indicators and Their Use; Three Types of Centering Mandrels; and Care of the Lathe.

INVENTORY CONTROL METHODS. 45 pages, 8 1/2 by 10 3/4 inches. Published by the Policyholders Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

This report on inventory control methods has been prepared on the basis of data contributed by a number of industrial companies that have developed sound practices of controlling inventories of supplies, materials, and finished goods. It outlines six basic elements which are normally part of a formal inventory control system. Copies can be obtained without charge by executives who address the Bureau on their business stationery.

GREATEST TIME-SAVER IN DEFENSE WORK

The sensational savings in time effected in metal working plants equipped with one or more DoAlls are easy to figure, but there are other savings, too intrinsic in value to measure — savings of energy, temper, and mental fag, when rush jobs at last move through in one-half to one-quarter the former time.

DO IT WITH A DoAll

Speed up production — cut corners — turn out better work. Wherever metal is shaped, cut and used, the DoAll is an equipment "must". Takes the place of shaping, milling and lathe work on hundreds of jobs.

Model V-36 DoAll with 36" throat handles large and odd-shaped parts at Northwest Airlines, St. Paul.

BAND FILER

Does faster, better, smoother continuous filing on all materials from high-carbon steel to brass, wood, etc. Your choice of 21 styles of file bands, ½", ⅜" and ¼" wide, flat, oval or half round.

DOALL GRINDER

A super precision surface grinder — a real production tool. Less vibration because motor is built right on the ball-bearing spindle. Work table has exceptionally large bearing surface. Hydraulic table travel is infinitely variable, up to 50 f.p.m.

MICROMETER

These special frames sawed in 45 minutes at Northwest Airlines.

PROPELLER WRENCH

Made at Northwest Airlines. Inside cut, 15 minutes. Outside cut, 30 minutes.

FREE - Literature and Technical Data on Contour Machining

Let us send a factory-trained man to your plant with a DoAll to show you what this remarkable machine tool can do for you.

CONTINENTAL MACHINES, Inc.

1312 S. Washington Ave., Minneapolis, Minn.

Associated with the DoAll Co., Des Plaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines.

Immediate Shipment

On DoAll Contour Machines

Because our manufacturing facilities were increased 400% early in 1940, before the defense program started.

Because we use arc welded construction for greater speed, and have developed a process of attaching pads that have machined surfaces, which eliminates handling and machining heavy frame work.

Every 40 minutes we take a DoAll off our 1,000-foot assembly line.

Like Detroit's auto plants—DoAlls are built as fast as needed—giving you higher value.

Now recognized as the indispensable machine tool, this new shape-cutting process has revolutionized machine shop practice throughout the world.

Again the progressiveness and foresight of the DoAll Organization is demonstrated in making immediate shipment to aid American industry in meeting today's demand for greater and faster production.

NO MACHINE TOOL "BOTTLENECK" HERE

CONTINENTAL MACHINES, INC., MINNEAPOLIS, MINN.

Associated with the DoAll Co., Des Plaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines.

OBITUARIES

Gifford K. Simonds

Gifford K. Simonds, president of the Simonds Saw & Steel Co., Fitchburg, Mass., died on March 20 in Brookline, Mass., at the age of sixty years. Mr. Simonds had been actively associated

Gifford K. Simonds

with the Simonds Company for forty-one years, during which he served for various periods as treasurer, director, general manager, and president. He originated the idea and supervised the construction of the controlled-conditions windowless plant of the company at Fitchburg. He is survived by his wife and four children.

FREDERICK C. BRYAN, for thirty years general traffic manager of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., died at his home in Milwaukee on April 7, following a heart attack, in his seventy-seventh year.

HARRY WILSON, SR., who was employed for sixty-five years continuously by the Jessop Steel Co., Washington, Pa., and its parent concern, Jessop of Sheffield, died at his home in Washington, Pa., on April 4, aged seventy-six years. Mr. Wilson began working for the parent concern at Sheffield, England, in 1875, when he was eleven years old. He started as a screw boy on the sheet mills and became a roller at the age of nineteen. In 1905, he was sent to America, where he became night superintendent of the sheet mills in the new plant that the Jessop Steel Co. had just established at that time in Washington, Pa., as a subsidiary of the Sheffield firm. He remained in this capacity until 1938, when he was given less arduous work. His two sons are also connected with the Jessop Steel Co.

WALTER J. HENRY, vice-president in charge of sales of the Boston Gear Works, Inc., North Quincy, Mass., passed away early in April at the age of forty-four years.

COMING EVENTS

MAY 5-7—Twenty-fifth annual convention of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead Hotel, Hot Springs, Va. J. C. McQuiston, secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 8-9—Forty-third annual convention of the NATIONAL METAL TRADES ASSOCIATION at the Palmer House, Chicago, Ill. Further information can be obtained from Homer D. Sayre, commissioner, 122 S. Michigan Ave., Chicago, Ill.

MAY 12-15—Annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION at the Hotel Pennsylvania, New York City. C. E. Hoyt, executive secretary, 222 W. Adams St., Chicago, Ill.

MAY 16-17—Conference on the HARDENING OF METALS at John Harrison Laboratory of Chemistry and Houston Hall, University of Pennsylvania, 34th and Spruce St., Philadelphia, Pa., under the auspices of the Philadelphia Chapter of the American Society for Metals, and the Department of Physics of the University. For further information, address Joseph H. Bockrath, 1815 Sedgley Ave. Philadelphia, Pa.

MAY 19-23—WESTERN METAL CONGRESS AND EXPOSITION to be held in Los Angeles, Calif., under the auspices of the American Society for Metals. The Congress will have headquarters at the Biltmore Hotel, and the Exposition will be held in the Pan American Auditorium. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

MAY 26-29—Twenty-sixth annual convention of the NATIONAL ASSOCIATION OF PURCHASING AGENTS at the Stevens Hotel, Chicago, Ill. For further information, address Wade R. Franklin & Associates, 205 W. Wacker Drive, Chicago, Ill.

JUNE 1-6 — Summer meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

JUNE 12-14—Thirteenth semi-annual meeting of the EASTERN PHOTOELASTICITY CONFERENCE at Cambridge, Mass., under the auspices of the Department of Mechanical Engineering at the Massachusetts Institute of Technology. Chairman of the local committee, W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.

JUNE 16-20—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Kansas City, Mo. C. E. Davies, secretary, 29 W. 39th St., New York City.

JUNE 23-27—Forty-fourth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS to be held at the Palmer House, Chicago, Ill., in conjunction with an exhibit of testing apparatus and related equipment. For further information, address the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

SEPTEMBER 17-19—Annual conference of the NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION at the Royal York Hotel, Toronto, Canada. For additional information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

OCTOBER 6-11—EXPOSITION OF POWER AND MECHANICAL ENGINEERING at the International Amphitheatre, Chicago, Ill. For further information, address Charles F. Roth, manager, Grand Central Palace, New York City.

OCTOBER 12-15—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Louisville, Ky. C. E. Davies, secretary, 29 W. 39th St., New York City.

OCTOBER 16-18 — Semi-annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS at the Royal York Hotel, Toronto, Canada. Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

OCTOBER 20-24—Twenty-third NATIONAL METAL CONGRESS AND EXPOSITION to be held in Convention Hall and Commercial Museum, Philadelphia, Pa. Further information can be obtained from W. H. Eisenman, secretary, American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio.

OCTOBER 30-NOVEMBER 1—National Aircraft Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Biltmore Hotel, Los Angeles, Calif. For further information, address John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

DECEMBER 1-5—Annual meeting of the AMERICAN SOCIETY OF MECHANICS ENGINEERS at the Hotel Astor, New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.